IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:
Doud, et al.

Attorney Docket No. 2189.006

U.S. Patent. No.: 10,329,653

Issued: June 25, 2019

Assignee: Terves, LLC

Mail Stop Ex Parte Reexam
Central Reexamination Unit Commissioner for Patents
United States Patent and Trademark Office P.O. Box 1450
Alexandria, VA 22313-1450

REQUEST FOR *EX PARTE* REEXAMINATION OF CLAIMS 1–5, 7–9, 11–16, 18–21, 23–50, 52–62, 64, 66, 67, and 69–76 OF U.S. PATENT NO. 10,329,653

Ecometal, Inc. ("Requester") respectfully requests *ex parte* reexamination of claims 1–5, 7–9, 11–16, 18–21, 23–50, 52–62, 64, 66, 67, and 69–76 ("the Challenged Claims") of U.S. Patent No. 10,329,653 (the "'653 Patent").

Chongqin Yanmei Tech. Co., Ltd. EX1008

REFERENCE LIST

Shorthand	Description
'653 Patent	U.S. Patent No. 10,329,653 B2
Medlin Declaration (Exhibit 1)	Declaration of Dana J. Medlin, Ph.D., P.E., FASM Under 37 C.F.R. § 1.68I in Support of Request for *Ex Parte* Reexamination of U.S. Patent No. 10,329,653
'653 Patent PH	Prosecution History for U.S. Patent No. 10,329,653 B2 (as USPTO has access to this record, Requester is not filing a copy of the prosecution history)
Chinese-Language Xiao	Chinese Patent Publication No. CN103343271A (Xiao) (Chinese-language accompanied by an English language abstract)
Xiao	Chinese Pat. Pub. No. CN 103343271 (Xiao) (Certified English Language Translation)
Hassan	Development of High Strength Magnesium Based Composites Using Elemental Nickel Particulates as Reinforcement. Hassan, S.F., Gupta, M., *Journal of Materials Science* 37, 2467–2474 (2002).
Abstract Comparison (Exhibit 3)	Abstract Comparison of the English-language abstract and "Abstract of the Disclosures" section of the Certified English-language translation of Chinese Pat. Pub. No. CN 103343271 (Xiao)
'425 Provisional	US Provisional Patent Application 61982425
Hai et al.	Review of Recent Studies in Magnesium Matrix Composters, Hai Zhi Ye, Xing Yang, Liu, *Journal of Materials Science 39 (2004)*
Hemanth	Fracture Behavior of Cryogenically solidified aluminum-alloy reinforced with Nano-ZrO2 Metal Matrix Composites (CNMMCs), Joel Hemanth. *Journal of Chemical Engineering and Materials Science Vol. 2(8), August 2011*

Shivanath	US Patent No. 5,476,632 (Shivanath, et al)
Shaw	Corrosion Resistance of Magnesium Alloys, Barbara A. Shaw, Pennsylvania State University. *ASM Handbook, Volume 13A Corrosion: Fundamentals, Testing, and Protection*
Al-Fe Phase Diagram	Al-Fe Diagram: Charles H. Henager, Hydrogen Permeation Barrier Coatings, Materials for the Hydrogen Economy, Chapter 8, CRC Press 2007, Editors: R. H. Jones, G. J. Thomas, pp 181-190
Al-Ni Phase Diagram	Al-Ni Diagram: Laszlo J. Kecskes et al., Army Research Laboratory ARL-TR-5507, April 2011, ACombustion Synthesis Reaction Behavior of Cold-Rolled Ni/Al and Ti/Al Multilayers. p. 5
Al-Cu Phase Diagram	Al-Cu Diagram: https://sites.google.com/site/eampotentials/Home/AlCu downloaded June 20, 2020.
Al-Ag Phase Diagram	Al-Ag Diagram: A. J. McAlister, Bull. Alloy Phase Diagrams, 8(6):526-533, 1987
Cu-Ni Phase Diagram	Cu-Ni Phase Diagram. *Teach Yourself Phase Diagrams and Phase Transformations*, Professor Mike Ashby, 5th Edition, March 2009 Cambridge
Cu-Ni Chart Phase Diagram	Illustrated portion of Cu-Ni Chart Phase Diagram. *Materials Science and Engineering, 6th Edition by Callister and Rethwisch, 2003*
Ag-Cu Phase Diagram	Ag-Cu Binary Phase Diagram. *ASM Metals Handbook, 8th Edition, Vol. 8, Metallography, Structures and Phase Diagrams, 1973*
Mg-Pb Phase Diagram	Mg-Pb Phase Diagram. *ASM Metals Handbook, 8th Edition, Vol. 8, Metallography, Structures and Phase Diagrams, 1973*

Al-Mg Phase Diagram	Al-Mg Phase Diagram. *ASM Metals Handbook, 8th Edition, Vol. 8, Metallography, Structures and Phase Diagrams, 1973*
Mg-Ni Phase Diagram	Mg-Ni Diagram. *ASM Metals Handbook, 8th Edition, Vol. 8, Metallography, Structures and Phase Diagrams, 1973*
Galvanic Series	Jones, D.A.; Principles and Prevention of Corrosion, 2nd Ed., 1996, p. 170 - Galvanic Series Table; 1996. Referred to by POSITAs.
Mass Balance (Exhibit 2)	Mass/Balance. Dana J. Medlin

I. INTRODUCTION

Ecometal, Inc. ("Requester") requests *ex parte* reexamination under 35 U.S.C. § 302 and 37 C.F.R. § 1.501 of claims 1–5, 7–9, 11–16, 18–21, 23–50, 52–62, 64, 66, 67, and 69–76 of U.S. Patent No. 10,329,653 ("the '653 Patent" and "the '653 Patent Claims"). This Request sets forth grounds pointing out each substantial new question of patentability based on prior patents and printed publications, which are likely to prevail based on the accompanying evidence, and as such, this Request should be granted and the '653 Patent Claims cancelled.

II. PAYMENT OF FEES PURSUANT TO 37 C.F.R. § 1.510(a)

Per 37 C.F.R. § 1.510(a), the Office is authorized to charge $6,300.00 and any additional fees to Deposit Account No. 602198.

III. RELATED PROCEEDINGS

The '653 Patent is the subject of a patent infringement lawsuit brought by the Patent Owner Terves, LLC against Requester and Mr. Nick Yuan in the U.S. District Court for the Northern District of Ohio, Case No. 1:19-cv-01611-M ("Related Litigation"). The '653 Patent was also the subject a petition for *inter partes* review initiated by Requester on September 11, 2020, IPR2020-1620. On March 1, 2021, the Patent Trial and Appeal Board issued a decision (Paper 9) denying institution based on its conclusion that Requester filed its petition for *inter partes* review more than one year after being served, pursuant to the Hague Convention, with a complaint alleging infringement of the '653 Patent.

IV. IDENTIFICATION OF CLAIMS FOR WHICH REXAMINATION IS REQUESTED (37 C.F.R. 1.510(b)(2))

Requester seeks *ex parte* reexamination of claims 1–5, 7–9, 11–16, 18–21, 23–50, 52–62, 64, 66, 67, and 69–76 ("'653 Patent Claims").

V. REQUESTER IS NOT ESTOPPED UNDER 35. U.S.C. 315(e)(1) or 35 U.S.C. 325(e)(1) FROM FILING THIS REQUEST (37 C.F.R. § 1.510(b)(6))

Requester certifies they are not estopped from filing this Request under 35 U.S.C. § 315(e)(1) or 35 U.S.C. § 325(e)(2). Requester is not a Petitioner in, nor is any real party in interest or privy of Requester in, an *inter partes* review (35 U.S.C. § 315(e)(1)) or a post-grant review (35 U.S.C. § 325((e)(1)) of the '653 Patent that has resulted in a final written decision.

1. OVERVIEW OF THE '653 PATENT

A. Effective Filing Date of the '653 Patent

The '653 Patent issued on June 25, 2019, from U.S. Patent Application No. 15/641,439, filed July 5, 2017. The '653 Patent claims priority to U.S. Provisional Application No. 61/981,425 (Ex. 1009), which was filed April 18, 2014 the earliest effective filing date of the '653 Patent.

B. The Specification

The '653 Patent's purported invention is a "magnesium composite for use as a dissolvable component in oil drilling" such as "a ball or other tool component in a well drilling or completion operation such as, but not limited to, a component that is seated in a hydraulic operation that can be dissolved away after use so that no drilling or removal of the component is necessary." Ex. 1001, at 1:48–59.[1] The '653 Patent describes the magnesium composite as used to form a "castable, moldable, or extrudable component." *Id.* at 2:19–20.

The inventive magnesium composite includes "at least 50 wt.% magnesium" with "one or more additives added to a magnesium or magnesium alloy to form the novel magnesium composite." *Id.* at 2:20–24. The "one or more additives can be selected and used in quantities so that galvanically-active intermetallic or insoluble precipitates form in the magnesium or

[1] The notation N:XX–YY refers to column (or page) number N, and lines XX to YY of a reference.

magnesium alloy while the magnesium or magnesium alloy is in a molten state and/or during the cooling of the melt." *Id.* at 2:24-29.

The '653 Patent further describes "one or more additives can be added to the molten magnesium or magnesium alloy at a temperature that is greater than the melting point of the one or more additives." *Id.* at 2:53–56. "Generally, the temperature of the molten magnesium or magnesium alloy is at least about 10°C less than the melting point of the additive added to the molten magnesium or magnesium alloy during the addition and mixing process, typically at least about 100° C less than the melting point of the additive added to the molten magnesium or magnesium alloy during the addition and mixing process." *Id.* at 3:2–8. The process may "achieve a specific galvanic corrosion rate in the entire magnesium composite and/or along the grain boundaries of the magnesium composite." *Id.* at 3:16–18.

The '653 Patent discloses the "invention adopts a feature that is usually a negative in traditional casting practices wherein a particle is formed during the melt processing that corrodes the alloy when exposed to conductive fields and is imbedded in eutectic phases, the grain boundaries, and/or even within grains with precipitation hardening." *Id.* at 3:19–24. Adoption of this previously-known "negative" feature "result[ed] in the ability to control where the galvanically-active phases are located in the final casting, as well as the surface area ratio of the in situ phase to the matrix phase, which enables the use of lower cathode phase loadings as compared to a powder metallurgical or alloyed composite to achieve the same dissolution rates;" thus, the in situ formed galvanic additives can be used to improve certain mechanical properties of the magnesium composite, including ductility, tensile strength, and/or shear strength. *Id.* at 3:24–30.

V. FIELD OF TECHNOLOGY

The field of endeavor of the '653 Patent is changing the physical structure of non-ferrous metals or alloys by heat treatment or by hot or cold working of magnesium or alloys based thereon.

For a detailed discussion of the background of the '653 Patent and Field of Technology, see the Medlin Declaration at ¶¶ 44–77.

VI. LEVEL OF ORDINARY SKILL IN THE PERTINENT ART

A POSITA at the time of filing of the '653 Patent, i.e., April 18, 2014, had at least a bachelor's degree in metallurgical, materials, or mechanical engineering, or the equivalent, and at least five years of experience in metallurgical and materials engineering, or an equivalent amount of relevant work and/or educational experience.

VII. STATEMENT POINTING OUT EACH SUBSTANTIAL NEW QUESTION OF PATENTABILITY (37 C.F.R. § 1.510(b)(1))

A. Prior Art Patents and Printed Publications Relied on

Requester relies on:

1. Certified English-Language Translation of Chinese Patent Publication No. CN 103343271 to Xiao *et al.* ("Xiao").

2. Development of High Strength Magnesium Based Composites Using Elemental Nickel Particulates as Reinforcement. Hassan, S.F., and Gupta, M., *Journal of Materials Science* 37, 2467–2474 (2002) ("Hassan").

A Reference List identifying the other exhibits relied upon in this request or the accompanying expert declaration is included, at p. 2, *supra.*

Xiao and Hassan were each published before the earliest claimed priority date of the '653 Patent Claims – April 18, 2014[2] (the "Priority Date"); thus, each is prior art to the '653 Patent Claims under at least AIA 35 U.S.C. § 102 and 35 U.S.C. § 103.

[2] **Effective Filing Date of the '653 Patent.** The '653 Patent issued on June 25, 2019, from U.S. Patent Application No. 15/641,439, filed July 5, 2017. The '653 Patent claims priority to U.S. Provisional Application No. 61/981,425 (Ex. 1009), which was filed April 18, 2014 the earliest effective filing date of the '653 Patent.

Specifically, Xiao was filed on July 8, 2013 and published October 9, 2013. Xiao qualifies as a printed publication and prior art under 35 U.S.C. § 102(a)(1). Hassan qualifies as a "printed publication" because it was "disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence [could] locate it" before the critical date, i.e. April 18, 2014. *SRI Int'l, Inc. v. Internet Sec. Sys.*, 511 F.3d 1186, 1194 (Fed. Cir. 2008); see also, *Voter Verified, Inc. v. Premier Election Solutions, Inc.*, 698 F.3d 1374, 1380 (Fed. Cir. 2012) (quoting *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989)).

Hassan was published in the June 2002 issue of the Journal of Materials Science, as: Hassan, S.F., Gupta, M. Development of high strength magnesium-based composites using elemental nickel particulates as reinforcement. *Journal of Materials Science* 37, 2467–2474 (2002). Hassan, cover page. Journal of Material Science was and is reputable, widely known, and readily accessible to POSITAs. Hassan bears a copyright date of 2002. *Id.*, *LG Elec., Inc.* v. *Advanced Micro Devices, Inc.*, IPR2015-00329, Paper 13, at 12 (PTAB Jul. 10, 2015) (copyright date is prima facie evidence of publication). Hassan further has conventional indicia of its accessibility prior to the critical date. *See Provepharm Inc. v. Wista Labs. Ltd.*, 2018 WL 3326805, at 7 (P.T.A.B. July 6, 2018). (If the "conventional markers" support a finding that the reference is prior art, then, "absent evidence to the contrary, [the Board] will have no reason to suspect otherwise."). Hassan was marked "Received 14 June 2001 and accepted 12 February 2002" by Kluwer Academic Publishers. Hassan, at 8. Volume 37, which contained Hassan, was assigned an ISSN number (0022-2461)—indicating it is published and available for public access. Moreover, Hassan was cited by POSITAs prior to April 18, 2014. (See, e.g., Hai, at 18; Hemanth, at 11.). Thus, Hassan qualifies as a printed publication and prior art under 35 U.S.C. § 102(a).

Section IX's Detailed Explanation includes several references that, though not necessary

to render the '653 Patent Claims anticipated/obvious and therefore not listed in the relied-on references above, provide evidentiary support for a POSITA's understandings of and motivations to combine the relied-on references. These references include:

- Formation of Magnesium Metal Matrix Composites Al203p/Az91D and Their Mechanical Properties After Heat Treatment, Lin et al. (showing known magnesium alloy represented by Mg-Al-Zn).

Should the office desire, this reference may be considered relied-on and part of the Proposed Ground (discussed below).

B. At least Xiao and Hassan raise Substantial New Questions of Patentability (SNQs")

a. Prosecution History of the '653 Patent

The '653 Patent was filed on July 5, 2017. On September 20, 2017, Patent Owner submitted an IDS disclosing eighty-eight references including Chinese Patent Publication No. CN103343271A (in Chinese) accompanied by an English language abstract ("Chinese-language Xiao"). The submitted references were considered by the examiner.

Following a Restriction Requirement and Patent Owner's response thereto, the Office issued a November 21, 2018 Office Action, rejecting claims 22, 24, 25, 29–32, 63, 64, 67–70, 75, 75, and 81–86 as anticipated by or, in the alternative, obvious over JP2013-019030 (Tashiharu referred to hereinafter as JP '030), and claims 66 and 72 as obvious over JP'030.

In response to this Office Action, Patent Owner responded to the rejections by claiming that they were moot in view of the amendments and, for a new claim 87, by arguing it that the CaMgSi phase in the magnesium alloy of JP'030 is likely not galvanically-active and would not corrode in the presence of a KCl water mixture because it discloses a magnesium alloy which is usable in "transport-airplane machines" and other materials of an automobile, an airplane and a rail car, a machine part, and a robot part article and that ***"a person having ordinary skill in the art***

would understand that those magnesium alloys that are used in automobiles either improve corrosion resistance or are corrosion resistant." (emphasis added).

A Notice of Allowance issued on March 27, 2019, finding the claims allowable because "the closest prior art of record," JP2013-019030 (Tashiharu JP'030) does not teach or suggest the additive(s) including copper, nickel, iron, or cobalt, or mixtures thereof.

b. SNQ Raised by Xiao

Requester asserts that a full English translation of Xiao teaches all features of claims 1–5, 9, 11, 29–32, 37–50, 52–54, 56–62, 64, 66, 67, 69, 70, and 72–73 and are thereby anticipated by Xiao, and claims 8, 25–28, 33–36, 55, and 74–78 are at least made obvious, by Xiao in combination with the prior art magnesium also disclosed in Xiao.

A Chinese language version of Xiao (with an English language abstract) was made of record in the '653 Patent in an IDS submitted by the Patent Owner dated September 20, 2017. The Information Disclosure Statement disclosed twenty-eight (28) U.S. Patents, thirty-two (34) U.S. Patent publications, fifteen (15) Foreign Patent Documents, and thirteen (13) Non-Patent Literature Documents. *Id.* at 201–209. The Foreign Patent Documents included Chinese Patent Publication No. CN103343271A (in Chinese) accompanied by an English language abstract (hereinafter referred to as "Chinese-language Xiao").

An English-language abstract of Xiao was provided to the Examiner. Using MS Word, Requester compared that English-language abstract to the "Abstract of the Disclosures" section of the Certified translation. Exhibit 3. The comparison shows that the abstracts would have been considered practically identical by a POSITA. Medlin Decl. Exhibit 2 at ¶ 84. However, both Abstracts failed to disclose the important subject matter of the Xiao reference: the Abstracts say nothing about Xiao's disclosures of galvanic-activity, corrosion or accelerating the dissolution.

Rather, the Abstracts say that "the alloy decomposition performance exceeds that of a traditional cast magnesium alloy." *Id.* This portion of the final sentence of the Xiao Abstract likely led the Examiner to incorrectly believe that Xiao—like much of the magnesium alloy prior art (see, *e.g.*, the '653 Patent, at 3:19-24) and JP'030 (considered the closest reference by the Examiner)—disclosed nothing more than "magnesium alloys [that] either improve corrosion resistance or are corrosion resistant." '653 PH, at 606–07. *In re Swanson*, 540 F.3d 1368, 1378 (Fed. Cir. 2008), clarified that a "substantial new question of patentability" refers to a question which has never been considered by the USPTO. The proper question is not whether a reference has been considered, but whether the particular question of patentability presented by the reference in reexamination was previously evaluated by the USPTO, taking into account the context and scope of the consideration. *Id.* at 1379–80. As such, the question of patentability presented by the English translation of the Xiao reference was certainly not evaluated by the USPTO during prosecution of the '653 patent because the USPTO did not have an English translation of the germane portion of the Xiao reference.

As detailed below in Section IX, the Xiao reference, when reviewed in its entirety, anticipates claims 1–5, 9, 11, 29–32, 37–50, 52–54, 56–62, 64, 66, 67, 69, 70, and 72–73 of the '653 patent and also renders claims 7–8, 12–16, 18–21, 23–28, 33–36, 55, 71, and 74–78 of the '653 patent obvious in view of Hassan. As such, the Xiao reference, in its entirety, presents a substantial new question of patentability.

c. SNQ Raised by Hassan

Requester also asserts that Hassan in combination with Xiao raises a substantial new question of patentability as claims 7, 12–16, 18–21, 23–24, and 71 are obvious over Xiao in

combination with Hassan as discussed below. The prosecution history of the '653 patent shows that Hassan was not considered by the Examiner during the prosecution of the '653 Patent.

Hassan (like Xiao) discloses "[m]agnesium based materials due to their inherently low density and ensuing potential to exhibit high specific mechanical properties are actively sought for weight-critical structural application." Hassan at 2467. Hassan discloses the "synthesis of monolithic and nickel reinforced magnesium composites (Mg/Nip)," including "superheating the magnesium turning with reinforcement particulates (placed in multi-layer sandwich form) to 750°C" and stirring the "molten slurry." *Id.* at 2468.

Hassan describes its study as using "magnesium turnings . . . as the base material and elemental nickel particulates of 99.9% purity (Johnson Matthey, MA, USA) with an average size of 29±19 μm were used as reinforcement phase." *Id.* at 2468. Figure 1 of Hassan demonstrates "representative SEM micrographs showing distribution of nickel and its reaction product in: (a) Mg/7.3 Nip, (b) Mg/14.0Nip and (c) Mg/24.9Nip matrices."

Further, Hassan also discloses that the deposited magnesium ingots may then be subjected to secondary processing. For example, Hassan teaches that the nickel-reinforced magnesium ingots are machined and hot extruded to obtain rods of 8 mm diameter. *Id.* Analysis of the composite of Hassan "showed the reduction in the size of elemental nickel particulates in the extruded composites" (see Table 1 of Hassan). In other words, the extrusion in Hassan resulted in a reduction of particulate size of the magnesium composite.

Hassan therefore contains disclosures that some of the additive material may remain "unreacted" with the molten magnesium; a reduction in particulate size of the additive material; and that the magnesium ingots may be subjected to secondary processing; none of these disclosures were considered by the Examiner during prosecution of the '653 Patent. As such, Hassan, when

viewed in combination with Xiao, raises a substantial new question of patentability with respect to whether or not 7, 12–16, 18–21, 23–24, and 71 are obvious.

C. No Other Proceeding Exists

According to the MPEP § 2242(I), a substantial new question of patentability is new so long as, in relevant part, it has not been "decided in an earlier concluded examination or review of the patent by the Office" such as "in an earlier concluded trial by the Patent Trial and Appeal Board." It is relevant that no other proceeding has been instituted regarding the '653 Patent; therefore, a substantial new question of patentability is at issue.

VIII. OVERVIEW OF INVALIDATING PRIOR ART

A. The English Translation version of Xiao

Xiao, entitled "Light and pressure-proof fast-decomposed cast magnesium alloy," discloses a "cast magnesium alloy, which can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique." Xiao, at ¶ 0001. Xiao explains "[i]n recent years, the United States has made breakthroughs in the technologies of shale gas exploration and development, and the output has grown rapidly." "After the completion of all rock fracturing, it is necessary to depressurize the well tubing to facilitate the later production of the oil and gas well. In the past, the conventional method is to use the low-layer pressure to push the ball back to the well opening, or use a drilling tool to drill the sliding sleeve ball seat and the tripping ball, so as to destroy them." *Id.* at ¶ 0002.

Xiao identifies the need for "the development of a tripping ball that can withstand the high pressure of fracturing construction and the high temperature at the bottom of the well, and has the feature of self-decomposition in the fluid environment of a well, can effectively reduce the construction risk and improve the construction efficiency." *Id.*

Xiao sought to meet this need by proposing a "method for preparing a light and pressure-proof fast-decomposed cast magnesium alloy by means of optimizing the alloy composition design using a self-made flux containing a rare earth element and adopting a smelting casting method." *Id.* at ¶ 0004. Specifically, Xiao discloses a "magnesium alloy with a high aluminum content (13 to 25% by weight) and a high zinc content (2 to 10% by weight), and further adds elements of Fe, Cu, Ni and Ag which can enhance the corrosion performance of the magnesium alloy, and at the same time adds Zr, Ti element as grain refiners to improve the compressive strength of the formed material, in which the purpose of adding the high content of aluminum is to produce a large amount of cathode phase, the β ($Mg_{17}Al_{12}$) phase and eutectic phase on the grain boundary of the magnesium alloy, and the magnesium matrix α phase functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." *Id.* at ¶ 0026.

Discussed in-depth, below, Xiao also discloses specific dissolution/decomposition rates of its novel magnesium composites. Specifically, Xiao includes the following table, which discloses the various dissolution/decomposition rates:

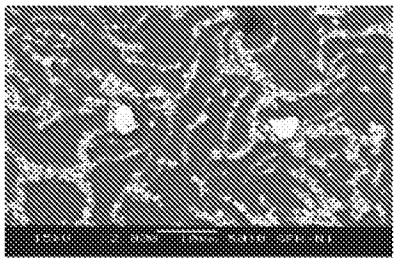
	Room temperature tensile strength σ_b (MPa)	Decomposition rate at 70 ℃ in 3% KCl solution ($g\,cm^{-2}.h^{-1}$)	Decomposition rate at 93 ℃ in 3% KCl solution ($g.cm^{-2}.h^{-1}$)
Comparative example 1	232	0.00026	0.0005
Example 1	360	0.035	0.074
Example 2	385	0.015	0.045
Example 3	410	0.013	0.036
Example 4	375	0.034	0.058
Example 5	392	0.025	0.048
Example 6	365	0.021	0.063
Example 7	387	0.036	0.057

Id. at ¶ 0064.

B. Hassan

Prior art Hassan (introduced above) recognized that "[m]agnesium based materials due to their inherently low density and ensuing potential to exhibit high specific mechanical properties are actively sought for weight-critical structural application." Ex. 1007 at 2467. Hassan discloses the "synthesis of monolithic and nickel reinforced magnesium composites (Mg/Nip)," including "superheating the magnesium turning with reinforcement particulates (placed in multi-layer sandwich form) to 750°C" and stirring the "molten slurry." *Id.* at 2468.

Hassan describes its study as using "magnesium turnings . . . as the base material and elemental nickel particulates of 99.9% purity (Johnson Matthey, MA, USA) with an average size of 29±19 μm were used as reinforcement phase." *Id.* at 2468. Figure 1 of Hassan demonstrates "representative SEM micrographs showing distribution of nickel and its reaction product in: (a) Mg/7.3 Nip, (b) Mg/14.0Nip and (c) Mg/24.9Nip matrices."



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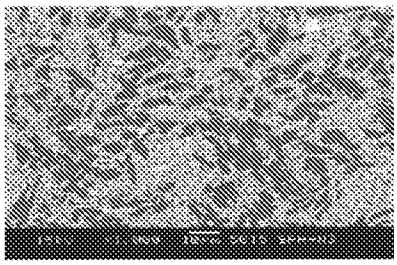

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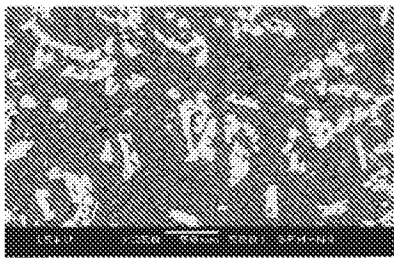

(c)

Hassan also discloses the deposited magnesium ingots may then be subjected to secondary processing. For example, Hassan teaches that the nickel-reinforced magnesium ingots are machined and hot extruded to obtain rods of 8 mm diameter. *Id.* Analysis of the composite of Hassan "showed the reduction in the size of elemental nickel particulates in the extruded composites" (see Table 1 of Hassan). In other words, the extrusion in Hassan resulted in a reduction of particulate size of the magnesium composite. Hassan was not considered by the patent examiner during the prosecution of the '653 Patent.

IX. DETAILED EXPLANATION OF THE PERTINENCY AND MANNER OF APPLYING THE CITED PRIOR ART TO THE '653 PATENT CLAIMS (37 C.F.R. § 1.510(b)(1)).

A. Ground 1: Claims 1–5, 9, 11, 29–32, 37–50, 52–54, 56–62, 64, 66, 67, 69, 70, and 72–73 are Anticipated by Xiao

i. Anticipation by Xiao

1. Anticipation

"When, as by a recitation of ranges or otherwise, a claim covers several compositions, the claim is 'anticipated' if one of them is in the prior art." *Titanium Metals Corp. v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985).

When the prior art discloses a range which touches or overlaps the claimed range, but no specific examples falling within the claimed range are disclosed, the reference anticipates the claims if the claimed subject matter is disclosed in the reference with "sufficient specificity." *See* MPEP 2131.03.

For a disclosure to be implicit or inherent it must be a necessary feature or result of an embodiment sufficiently described and enabled in the prior art reference. (In other words, that a certain result or characteristic may occur or be present in the prior art reference is not enough; that certain result or characteristic must always occur (or be present) for the result or characteristic to be implicitly or inherently disclosed.) However, it is not necessary that POSITA would have recognized that implicit or inherent disclosure at the time of invention. See, e.g., *MEHL/Biophile Int'l Corp. v. Milgraum*, 192 F.3d 1362, 1365 (Fed. Cir. 1999).

"To serve as an anticipation when the reference is silent about the asserted **inherent** characteristic, such gap in the reference may be filled with recourse to extrinsic evidence. Such evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill."

Continental Can Co. USA v. Monsanto Co., 948 F.2d 1264, 1268, 20 USPQ2d 1746, 1749-50 (Fed. Cir. 1991) ("this modest flexibility in the rule that 'anticipation' requires that every element of the claims appear in a single reference accommodates situations in which the common knowledge of technologists is not recorded in the reference; that is, where technological facts are known to those in the field of the invention, albeit not known to judges."). Note that as long as there is evidence of record establishing inherency, failure of those skilled in the art to contemporaneously recognize an **inherent** property, function or ingredient of a prior art reference does not preclude a finding of anticipation. *Atlas Powder Co. v. IRECO, Inc.*, 190 F.3d 1342, 1349, 51 USPQ2d 1943, 1948 (Fed. Cir. 1999) (Two prior art references disclosed blasting compositions containing water-in-oil emulsions with identical ingredients to those claimed, in overlapping ranges with the claimed composition. The only element of the claims arguably not present in the prior art compositions was "sufficient aeration . . . entrapped to enhance sensitivity to a substantial degree." The Federal Circuit found that the emulsions described in both references would inevitably and inherently have "sufficient aeration" to sensitize the compound in the claimed ranges based on the evidence of record (including test data and expert testimony). This finding of inherency was not defeated by the fact that one of the references taught away from air entrapment or purposeful aeration.).

If the claimed composition is identical to a composition disclosed by a prior art reference, it does not matter that the applicant recognized additional properties of that composition. *See Titanium Metals Corp. of America v. Banner*, 778 F.2d at 782. *See also In re Spada*, 911 F.2d 705 (Fed. Cir. 1990) ("[t]he discovery of a new property or use of a previously known composition, even when that property and use are unobvious from the prior art, cannot impart patentability to claims to the known composition").

In *Titanium Metals*, the Federal Circuit found that the prior art anticipated the claims at issue despite the alleged newly-discovered property of the claimed composition. The claims were directed to a titanium base alloy containing certain percentages of particular metals and having good corrosion resistance. The Federal Circuit found the claims anticipated by a Russian article, which disclosed an alloy having percentages of metals falling within those claimed. The applicants argued that the prior art did not disclose the newly-discovered corrosion resistance property. The court rejected this argument. It reiterated the well-established rule that the recitation of a newly-discovered property in a claim does not render novel an otherwise known composition where that property is inherent in the composition. *Titanium Metals Corp. of America v. Banner*, 778 F.2d at 782.

As stated in *Scripps Clinic & Research Foundation v. Genentech, Inc.* 927 F.2d 1565, 1567–77 (Fed. Cir. 1991):

> It is sometimes appropriate to consider extrinsic evidence to explain the disclosure of a reference. Such factual elaboration is necessarily of limited scope and probative value, for a finding of anticipation requires that all aspects of the claimed invention were already described in a single reference: a finding that is not supportable if it is necessary to prove facts beyond those disclosed in the reference in order to meet the claim limitations. The role of extrinsic evidence is to educate the decision-maker to what the reference meant to persons of ordinary skill in the field of the invention, not to fill gaps in the reference. *See Studiengesellschaft Kohle, mbH v. Dart Industries, Inc.*, 726 F.2d 724, 727, 220 USPQ 841, 842 (Fed.Cir.1984) (although additional references may serve to reveal what a reference would have meant to a person of ordinary skill, it is error to build "anticipation" on a combination of these references). If it is necessary to reach beyond the boundaries of a single reference to provide missing disclosure of the claimed invention, the proper ground is not § 102 anticipation, but § 103 obviousness.

1. Independent Claims 1, 29, 37, 41, 45, 49, and 73 and Dependent Claims 2–5, 9, 11, 30–32, 38–40, 42–44, 46–48, 50, 52–54, 56–62, 64, 66, 67, 69, 70, and 72 are Anticipated by Xiao

Pursuant to 37 C.F.R. § 1.510 and MPEP § 2214, Requester provides the following charts depicting where claim elements are present in the prior art. The grounds, below, and the concurrently-submitted Declaration of Dr. Dana J. Medlin provide a detailed explanation of the pertinency and manner of applying the prior art to each element of the Challenged Claims. For each challenged dependent claim, if not explicitly stated, Requester incorporates its analysis for each claim (independent or dependent) from which the challenged dependent claim depends:

'653 Patent Claims/Elements	**Anticipated by Disclosures of CN 103343271 A Xiao et al. ("Xiao")**
Independent Claim 1	**Disclosure of Claim Element in Xiao**
1. A magnesium composite that includes in situ precipitation of galvanically-active intermetallic phases to enable controlled dissolution of said magnesium composite,	Xiao discloses a "magnesium composite", i.e., "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." ¶ 0026, ll. 1-3. Xiao also discloses a magnesium composite that includes in situ precipitation of galvanically-active intermetallic phases to enable controlled dissolution of said magnesium composite. Specifically, Xiao discloses a novel magnesium alloy (i.e., magnesium composite) with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the

	magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." ¶ 0026. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Thus, this claim element was disclosed by Xiao.
said magnesium composite comprising a mixture of magnesium or a magnesium alloy and an additive material,	Xiao discloses "first loading pure magnesium and pure aluminum into a smelting furnace . . . next loading pure zinc and an [sic] intermediate alloys of trace element components into a resulting magnesium-aluminum alloy melt after melting." ¶ 0022. This is a "magnesium composite comprising a mixture of magnesium or a magnesium alloy." Xiao also discloses "an additive material", i.e., Xiao discloses that "Al-Fe ... Al-Ni ... Al-Cu ... Al- Ag ... Al-Zr ... and ... Al-Ti intermediate alloy[s], are heated to dry and then added to the magnesium-aluminum alloy melt." Id. at ¶ 0023. An additive material is a material that is added. The addition of these intermediate alloys to the melted magnesium alloy necessarily results in a mixture of the additive material and magnesium alloy.

said additive material having a greater melting point temperature than a solidus temperature of said magnesium,	Using a typical phase diagram, a POSITA in April 2014 would have readily determined that "said additive material having a greater melting point temperature than a solidus temperature of said magnesium." The solidus temperature of magnesium is the temperature at which a metal first begins to melt during heating and not necessarily when the metal is completely liquidus. A POSITA would also use this phase diagram to find the solidus temperature of the magnesium-aluminum alloy disclosed in Xiao to be in a range of 650°C for pure magnesium and down to 437°C for aluminum additions in the range of 13 wt% to 25% and even up to 40 wt%. The POSITA using typical phase diagrams for each of the additive materials (here the Al-Fe, Al-Ni, Al-Cu, Al-Ag, Al-Zr, Al-Ti "intermediate alloys" disclosed in Xiao) would be able to readily determine the melting point temperature (i.e. "temperature at which liquid is first formed" for each intermediate alloy. (¶ 0023). For example, the Al-Fe phase diagram (Ex. 1205) shows a variable melting point temperature ranging from 1538°C (pure iron) down to 655°C for a eutectic temperature between about 63 wt% aluminum to near 99 wt% aluminum. The Al-Ni phase diagram (Ex. 1206) shows a variable melting point temperature that ranges from 1640°C down to 640°C depending upon the alloy content. The Al-Cu (Ex. 1207) phase diagram shows a variable melting point temperature ranging from 548°C up to 1084°C depending upon the alloy mixture. A POSITA in April 2014 would have readily determined the specific melting temperature of a specific alloy mixture based on these phase diagrams.

	Xiao discloses a variety of Al-Fe, Al-Ni, Al-Cu, Al-Ag, Al-Zr, Al-Ti alloy mixtures with a variety of constituencies. For instance, Xiao specifically teaches in Example 7 that: The composition of the alloy and the respective percentages by weight are as follows: 25% Al-10% Zn-1% Fe-0.5% Ni-0.1% Cu- 0.5% Ti-0.05% Zr, and the remainder is Mg. ¶ 0058-59. Xiao teaches that the magnesium alloy of Example 7, as a whole, ends up with the maximum amount of aluminum (i.e. 25 wt%) taught as being within the invention of Xiao (see, ¶ 0026). Xiao specifically discloses—with respect to Example 7—that portions of that aluminum content are added into a magnesium-aluminum melt as an Al-Fe intermediate alloy, an Al-Ni intermediate alloy, an Al-Cu intermediate alloy, an Al-Ag intermediate alloy, an Al-Zr intermediate alloy, and an Al-Ti intermediate alloy. ¶ 0060. By converting weight percentages to grams and calculating mass balances, a POSITA would first determine the relative concentrations of the pure magnesium and pure aluminum initially loaded into the smelting furnace in order to determine its solidus temperature. As a result, a POSITA would have understood in April 2014 that Example 7 of Xiao includes 62.85 total grams of magnesium. The following intermediate alloy compositions were chosen for the initial mass balance calculations: Al-Fe (30 wt% Fe), Al-Ni (45 wt% Ni), Al-Cu (40 wt% Cu), Al-Ti (10 wt% Ti), Al-Zr (20 wt% Zr) alloy mixtures. A POSITA in April 2014 would have performed the initial mass balances, included herewith as the Mass/Balance Exhibit 2, on these compositions. Using these initially selected alloy compositions would have resulted in 7.79 grams of Aluminum being added as components of the intermediate alloys. Since Example 7 of Xiao calls for a total of 25 grams (i.e. 25 wt%) of Aluminum, 17.21 grams of

	Aluminum would have had to have been initially loaded into the smelting furnace in Example 7 along with the 62.85 grams of magnesium (see calculation above). Thus, the initial melt of Example 7 (using the intermediate alloys selected) would have had a composition of 78.5 wt% Mg and 21.5 wt% Al. A POSITA in April 2014 would have next consulted the Mg-Al phase diagram to determine that the solidus temperature of that initial magnesium alloy (i.e. 78.5 wt% Mg and 21.5 wt% Al) would be 437 °C. A POSITA would also consult the relevant phase diagram to determine the melting point temperature of the various additive materials disclosed in Xiao. Id. at ¶ 122. An aluminum-iron alloy with 30 wt% iron would have a melting point temperature of 655 °C, an aluminum-nickel alloy with 45 wt% Ni would have a melting point temperature of 854 °C, an aluminum-copper alloy with 40 wt% Cu would have a melting point temperature of 548°C, an aluminum-titanium alloy with 10 wt% Ti would have a melting point temperature of 665°C, and an aluminum-zirconium alloy with 20 wt% Zr would have a melting point temperature of 661°C. Thus, each of these additive materials from Example 7 of Xiao (with the constituencies selected above) would have had a greater melting point temperature than the solidus temperature (i.e. 437°C) of the magnesium-aluminum alloy (78.5 wt% Mg and 21.5 wt% Al) calculated as the amount of pure aluminum and magnesium initially loaded into the smelting furnace in Example 7. A POSITA in April 2014 would have recognized that other compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys having greater melting point temperatures than the solidus temperature of initial magnesium

	alloy loaded in the various disclosures of Xiao. Thus, Xiao discloses all of the limitations of this claim element.
said additive material constituting about 0.05 wt %-45 wt % of said mixture,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which a POSITA could calculate the specific weight percentage (ranges) of each additive material or secondary metal. In doing so, a POSITA would determine that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. A POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt%

	to 45 wt% of the mixture. Accordingly, this claim element was disclosed by Xiao.
said additive material forming precipitant in said magnesium composite,	Xiao teaches said additive material forming precipitant in said magnesium composite. Specifically, Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro- batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao.

	These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
said additive material includes one or more metals selected from the group consisting of copper, nickel, iron, and cobalt,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said magnesium composite has a dissolution rate of at least 5 $mg/cm^2/hr$. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. The disclosed table provides seven examples (excluding the comparative [prior art] example). ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate of at least three times the claimed "at least 5 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than

	seven times that floor). A POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "at least of 5 mg/cm2/hr" at the claimed 90°C.
Dependent Claim 2	**Disclosure of Claim Element in Xiao**
2. The magnesium composite as defined in claim 1, wherein said magnesium alloy includes over 50 wt % magnesium and one or more metals selected from the group consisting of aluminum, boron, bismuth, zinc, zirconium, and manganese.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." ¶ 0026, ll. 1-3. Claim 1 of Xiao specifically discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Claim 1 (emphasis added). Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed range set forth in these claim elements. Xiao teaches 0.05-0.5 wt% zirconium and 2-15 wt% zinc. A claim is invalid as anticipated when it is in Markush form and a prior art reference discloses one of the claimed elements. See Fresenius USA, Inc. v. Baxter Int'l, Inc., 582 F.3d 1288, 1298 (Fed. Cir. 2009). See also Abbott Labs. v. Baxter Pharm. Prods., Inc., 334 F.3d 1274, 1280 (Fed.Cir.2003); Schering Corp. v. Geneva Pharms., Inc., 339 F.3d 1373, 1380 (Fed.Cir.2003); Thus, Xiao teaches all of these claim limitations.
Dependent Claim 3	**Disclosure of Claim Element in Xiao**
3. The magnesium composite as defined in claim 1, wherein said magnesium alloy includes over 50 wt % magnesium and one or more metals selected from the	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." ¶ 0026, ll. 1-3. Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to

group consisting of aluminum in an amount of about 0.5-10 wt %, zinc in amount of about 0.1-3 wt %, zirconium in an amount of about 0.01-1 wt %, manganese in an amount of about 0.15-2 wt %, boron in amount of about 0.0002-0.04 wt %, and bismuth in amount of about 0.4-0.7 wt %.	25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Claim 1. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed range set forth in these claim elements. This claim element is taught solely by the zirconium concentrations falling within the 0.01-3 wt% range. Claim 3 also requires, in addition to a similar zirconium concentration to the Markush claims, a zinc concentration of 0.1-3 wt%. Xiao teaches 0.05-0.5 wt% zirconium, which touches and covers at least a portion of these claimed ranges. Xiao similarly teaches 2-15 wt% zinc, which covers much of the claimed (0.1-3 wt%) zinc concentration. A claim is invalid as anticipated when it is in Markush form and a prior art reference disclosed one of the claimed elements. See Fresenius USA, Inc. v. Baxter Int'l, Inc., 582 F.3d 1288, 1298 (Fed. Cir. 2009). See also Abbott Labs. v. Baxter Pharm. Prods., Inc., 334 F.3d 1274, 1280 (Fed.Cir.2003); Schering Corp. v. Geneva Pharms., Inc., 339 F.3d 1373, 1380 (Fed.Cir.2003); Thus, Xiao teaches all of these claim limitations.
Dependent Claim 4	**Disclosure of Claim Element in Xiao**
4. The magnesium composite as defined in claim 1, wherein said additive material includes nickel,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." ¶ 0026, ll. 1-3. Xiao teaches the use of a variety of metals as additive materials. See, e.g., ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti

	and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, nickel, among other metals. Thus, Xiao discloses a number of metal additives, including nickel, and hence fully discloses all of the limitations of this claim element.
said nickel constitutes about 0.05-35 wt % of said magnesium composite,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." [Emphasis Added] These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which a POSITA could calculate the specific weight percentage (ranges) of each additive material or secondary metal. In doing so, a POSITA would determine that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. A POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of

	Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 35 wt% of the mixture. Accordingly, this claim element was disclosed by Xiao.
Dependent Claim 5	**Disclosure of Claim Element in Xiao**
5. The magnesium composite as defined in claim 1, wherein said additive material includes copper,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." ¶ 0026, ll. 1-3. Xiao teaches the use of a variety of metals as additive materials. See, e.g., ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. [Emphasis Added]. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, among other metals. Thus, Xiao discloses a number of metal additives, including copper, and hence fully discloses all of the limitations of these claim elements.
said copper constitutes about 0.05-35 wt % of said magnesium composite,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." [Emphasis Added]

	These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which a POSITA could calculate the specific weight percentage (ranges) of each additive material or secondary metal. In doing so, a POSITA would determine that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. A POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 35 wt% of the mixture. Accordingly, this claim element was disclosed by Xiao.
said copper forms galvanically-active in situ precipitate in said magnesium composite.	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of

	micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 9	**Disclosure of Claim Element in Xiao**
9. The magnesium composite as defined in claim 1, wherein a dissolution rate of said magnesium composite is about 5-325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. The disclosed table provides seven examples (excluding the comparative [prior art] example). ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000.

	Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate within the claimed range of "about 5-325 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor). A POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "about 5" mg/cm2/hr at the claimed 90°C.
Dependent Claim 11	**Disclosure of Claim Element in Xiao**
11. The magnesium composite as defined in claim 1, wherein said additive material is a metal or metal alloy.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." ¶ 0026, ll. 1-3. Xiao teaches the use of a variety of metals as additive materials. See, e.g., ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal(s). Accordingly, Example 7 of Xiao discloses this claim element.
Independent Claim 29	**Disclosure of Claim Element in Xiao**
29. A dissolvable magnesium alloy composite for use in a ball or other tool component in a well drilling or completion operation,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶¶ 104-105 (Claim 1)).

	Xiao discloses that the cast magnesium alloy "can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique." ¶ 0001. A POSITA would have understood that a tripping ball was a type of ball or other tool component in an oil well drilling operation. Medlin Decl. Exhibit 2 at ¶ 148.
said dissolvable magnesium alloy composite comprising 60-95 wt % magnesium; 0.01-1 wt % zirconium; and about 0.05-45 wt % of a secondary metal	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements. The zirconium concentrations taught by Xiao fall within the claimed 0.01-1 wt% range. Claim 1 of Xiao discloses "Al: 13 to 25%, Zn: 2 to 15%," and Claim 2 of Xiao discloses secondary metals of "Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Thus, Xiao teaches 0.05-0.5 wt% zirconium, which touches and covers at least a portion of these claimed ranges. Medlin Decl. Exhibit 2 ¶ 150. Xiao similarly teaches 2-15 wt% zinc, which covers much of the claimed (0.05-6 wt%) zinc concentration. Id. at ¶ ¶ 167-68. A claim is invalid as anticipated when it is in Markush form and a prior art reference discloses

	one of the claimed elements. See Fresenius USA, Inc. v. Baxter Int'l, Inc., 582 F.3d 1288, 1298 (Fed. Cir. 2009). See also Abbott Labs. v. Baxter Pharm. Prods., Inc., 334 F.3d 1274, 1280 (Fed.Cir.2003); Schering Corp. v. Geneva Pharms., Inc., 339 F.3d 1373, 1380 (Fed.Cir.2003); These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum- nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, this claim element was disclosed by Xiao.
to form a galvanically-active intermetallic particle that promotes corrosion of said	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao

dissolvable magnesium alloy composite,	explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
said secondary metal including one or more metals selected from the group consisting of copper, nickel, cobalt, titanium and iron,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said magnesium alloy composite has a dissolution rate of at least 5 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064.

	Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate of at least three times the claimed "at least 5 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "at least of 5 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 30	**Disclosure of Claim Element in Xiao**
30. The dissolvable magnesium alloy composite as defined in claim 29, wherein a dissolution rate of said magnesium alloy composite is 5-325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate within the claimed range of "about 5-325 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in

	April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "about 5" mg/cm2/hr at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 31	**Disclosure of Claim Element in Xiao**
31. The dissolvable magnesium composite as defined in claim 29, wherein said secondary metal includes nickel,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including nickel, among other metals. Medlin Decl. Exhibit 2, at ¶ 145. Thus, Xiao discloses a number of metal additives, including nickel, and hence fully discloses all of the limitations of this claim element.
said nickel forms galvanically-active in situ precipitate in said magnesium composite.	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase

	which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2, at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 32	**Disclosure of Claim Element in Xiao**
32. The dissolvable magnesium alloy composite as defined in claim 29, wherein said additive material is a metal or metal alloy.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%,

	Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . .” Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these additive materials contain metal(s). Medlin Decl. Exhibit 2, at ¶ 145. Accordingly, Example 7 of Xiao discloses this claim element in accordance with Patent Owner’s definition of “additive material.”
Independent Claim 37	**Disclosure of Claim Element in Xiao**
37. A dissolvable magnesium alloy composite for use in a ball or other tool component in a well drilling or completion operation,	Xiao discloses a “magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy...” Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao discloses that the cast magnesium alloy “can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique.” ¶ 0001. A POSITA would have understood that a tripping ball was a type of ball or other tool component in an oil well drilling operation. Medlin Decl. Exhibit 2, at ¶ 148. Thus, these claim elements were disclosed by Xiao.
said dissolvable magnesium alloy composite comprising 60-95 wt % magnesium; 0.05-6 wt % zinc; 0.01-1 wt % zirconium;	Claim 1 of Xiao discloses a “magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%.” Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2, at ¶ 149. Dr. Medlin also notes that the “Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%.” Id. Thus, Xiao

	discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements. Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2, at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao.

and about 0.05-45 wt % of a secondary metal to form a galvanically-active intermetallic particle that promotes corrosion of said dissolvable magnesium alloy composite,	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2, at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
said secondary metal including one or more metals	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the

selected from the group consisting of copper, nickel, cobalt, titanium and iron,	novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Medlin Decl. Exhibit 2, at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said magnesium alloy composite has a dissolution rate of at least 5 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2, at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2, at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate of at least three times the claimed "at least 5 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above

	the claimed floor of "at least of 5 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 38	**Disclosure of Claim Element in Xiao**
38. The dissolvable magnesium alloy composite as defined in claim 37, wherein a dissolution rate of said magnesium alloy composite is 5-325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2, at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2, at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate within the claimed range of of at least three times the claimed "about 5-325 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "about 5" "about 5-325 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 39	**Disclosure of Claim Element in Xiao**
39. The dissolvable magnesium composite as defined in claim 37, wherein said secondary metal includes nickel,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)).

	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including nickel, among other metals. Medlin Decl. Exhibit 2, at ¶ 145. Thus, Xiao discloses a number of metal additives, including nickel, and hence fully discloses all of the limitations of these claim elements.
said nickel forms galvanically-active in situ precipitate in said magnesium composite.	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2, at ¶ 107.

	A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 40	**Disclosure of Claim Element in Xiao**
40. The dissolvable magnesium alloy composite as defined in claim 37, wherein said additive material is a metal or metal alloy.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these additive materials contain metal(s). Medlin Decl. Exhibit 2, at ¶ 145. Accordingly, Example 7 of Xiao discloses this claim element in accordance with Patent Owner's definition of "additive material."
Independent Claim 41	**Disclosure of Claim Element in Xiao**

41. A dissolvable magnesium alloy composite for use in a ball or other tool component in a well drilling or completion operation,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao discloses that the cast magnesium alloy "can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique." ¶ 0001. A POSITA would have understood that a tripping ball was a type of ball or other tool component in an oil well drilling operation. Medlin Decl. Exhibit 2, at ¶ 148. Thus, these claim elements were disclosed by Xiao.
said dissolvable magnesium alloy composite comprising over 50 wt % magnesium; one or more metals selected from the group consisting of 0.5-10 wt % aluminum, 0.1-2 wt % zinc, 0.01-1 wt % zirconium, and 0.15-2 wt % manganese;	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2, at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements. This claim element would be anticipated solely by the zirconium concentrations falling within the 0.01-1 and/or 0.01-3 wt% ranges. Claim 41 also requires, in addition to a similar zirconium concentration to the Markush claims, a zinc concentration of 0.1-2 wt%.

	Claim 1 of Xiao discloses "Al: 13 to 25%, Zn: 2 to 15%," and Claim 2 of Xiao discloses secondary metals of "Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Thus, Xiao teaches 0.05-0.5 wt% zirconium, which touches and covers at least a portion of these claimed ranges. Medlin Decl. Exhibit 2, ¶ 150. Xiao similarly teaches 2-15 wt% zinc, which covers much of the claimed (0.05-6 wt%) zinc concentration. Id. at ¶ ¶ 167-68. A claim is invalid as anticipated when it is in Markush form and a prior art reference disclosed one of the claimed elements. See Fresenius USA, Inc. v. Baxter Int'l, Inc., 582 F.3d 1288, 1298 (Fed. Cir. 2009). See also Abbott Labs. v. Baxter Pharm. Prods., Inc., 334 F.3d 1274, 1280 (Fed.Cir.2003); Schering Corp. v. Geneva Pharms., Inc., 339 F.3d 1373, 1380 (Fed.Cir.2003); Thus, Xiao teaches all of these claim limitations. Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057--0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2, at ¶¶ 113--122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall

	well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao. Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro- batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
and about 0.05-45 wt % of a secondary metal to form a galvanically-active intermetallic particle that	A POSITA in August 2014 would have understood the disclosure in Xiao of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2, at ¶ 107.

promotes corrosion of said dissolvable magnesium alloy composite,	A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao.
said secondary metal including one or more metals selected from the group consisting of copper, nickel and cobalt,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Medlin Decl. Exhibit 2, at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said magnesium alloy composite has a dissolution rate of at least 5 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2, at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to

	mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2, at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate of at least three times the claimed "at least 5 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "at least of 5 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 42	**Disclosure of Claim Element in Xiao**
42. The dissolvable magnesium alloy composite as defined in claim 41, wherein a dissolution rate of said magnesium alloy composite is 5-325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2, at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2, at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate within the claimed range of of at least three times the claimed "about 5-325 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of

	"about 5" "about 5-325 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 43	**Disclosure of Claim Element in Xiao**
43. The dissolvable magnesium composite as defined in claim 41, wherein said secondary metal includes nickel,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Medlin Decl. Exhibit 2, at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said nickel forms galvanically-active in situ precipitate in said magnesium composite.	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the

	grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2, at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 44	**Disclosure of Claim Element in Xiao**
44. The dissolvable magnesium alloy composite as defined in claim 41, wherein said additive material is a metal or metal alloy.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses

	intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these additive materials contain metal(s). Medlin Decl. Exhibit 2, at ¶ 145. Accordingly, Example 7 of Xiao discloses this claim element in accordance with Patent Owner's definition of "additive material."
Independent Claim 45	**Disclosure of Claim Element in Xiao**
45. A dissolvable magnesium alloy composite for use in a ball or other tool component in a well drilling or completion operation,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao discloses that the cast magnesium alloy "can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique." ¶ 0001. A POSITA would have understood that a tripping ball was a type of ball or other tool component in an oil well drilling operation. Medlin Decl. Exhibit 2 at ¶ 148. Thus, these claim elements were disclosed by Xiao. Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In

	particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao.
said dissolvable magnesium alloy composite comprising over 50 wt % magnesium; one or more metals selected from the group consisting of 0.1-3 wt % zinc, 0.01-1 wt % zirconium, 0.05-1 wt % manganese, 0.0002-0.04 wt % boron, and 0.4-0.7 wt % bismuth; and about 0.05-45 wt % of a secondary metal to form a galvanically-active intermetallic particle that promotes corrosion of said dissolvable magnesium alloy composite	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements. All of the foregoing Markush claim elements (i.e., Claims 25, 41, 45, and 55) and this claim element of Claim 29 would be anticipated solely by the zirconium concentrations falling

	within the 0.01-1 and/or 0.01-3 wt% ranges. Claim 37 also requires, in addition to a similar zirconium concentration to the Markush claims, a zinc concentration of 0.05-6 wt%. Claim 1 of Xiao discloses "Al: 13 to 25%, Zn: 2 to 15%," and Claim 2 of Xiao discloses secondary metals of "Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Thus, Xiao teaches 0.05-0.5 wt% zirconium, which touches and covers at least a portion of these claimed ranges. Medlin Decl. Exhibit 2 ¶ 150. Xiao similarly teaches 2-15 wt% zinc, which covers much of the claimed (0.05-6 wt%) zinc concentration. Id. at ¶ ¶ 167-68. A claim is invalid as anticipated when it is in Markush form and a prior art reference disclosed one of the claimed elements. See Fresenius USA, Inc. v. Baxter Int'l, Inc., 582 F.3d 1288, 1298 (Fed. Cir. 2009). See also Abbott Labs. v. Baxter Pharm. Prods., Inc., 334 F.3d 1274, 1280 (Fed.Cir.2003); Schering Corp. v. Geneva Pharms., Inc., 339 F.3d 1373, 1380 (Fed.Cir.2003); Thus, Xiao teaches all of these claim limitations. Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro- batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id.

	These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
said secondary metal including one or more metals selected from the group consisting of copper, nickel, and cobalt,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said magnesium alloy composite has a dissolution rate of at least 5 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate of at least three times the claimed "at least 5 mg/cm2/hr in 3 wt.% KCl

	water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "at least of 5 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 46	**Disclosure of Claim Element in Xiao**
46. The dissolvable magnesium alloy composite as defined in claim 45, wherein a dissolution rate of said magnesium alloy composite is 5-325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate within the claimed range of "about 5-325 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "about 5" mg/cm2/hr at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 45	**Disclosure of Claim Element in Xiao**
47. The dissolvable magnesium composite as defined in claim 45, wherein	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9.

said secondary metal includes nickel,	See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including nickel, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including nickel, and hence fully discloses all of the limitations of these claim elements.
said nickel forms galvanically-active in situ precipitate in said magnesium composite.	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a

	reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 48	**Disclosure of Claim Element in Xiao**
48. The dissolvable magnesium alloy composite as defined in claim 45, wherein said additive material is a metal or metal alloy.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these additive materials contain metal(s). Medlin Decl. Exhibit 2 at ¶ 145. Accordingly, Example 7 of Xiao discloses this claim element in accordance with Patent Owner's definition of "additive material."

Independent Claim 49	Disclosure of Claim Element in Xiao
49. A magnesium composite that includes in situ precipitation of galvanically-active intermetallic phases to enable controlled dissolution of said magnesium composite,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Xiao at ¶ 0026. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao.

said magnesium composite comprising a mixture of magnesium or a magnesium alloy and an additive material,	Xiao discloses "first loading pure magnesium and pure aluminum into a smelting furnace . . . next loading pure zinc and an [sic] intermediate alloys of trace element components into a resulting magnesium-aluminum alloy melt after melting." Xiao, at ¶ 0022. Xiao discloses that "Al-Fe ... Al-Ni ... Al-Cu ... Al-Ag ... Al-Zr ... and ... Al-Ti intermediate alloy[s], are heated to dry and then added to the magnesium-aluminum alloy melt." Id. at ¶ 0023. These intermediate alloys meet the Patent Owner's definition of "additive material," i.e., "a material that is added." Medlin Decl. Exhibit 2, at ¶ 110. The addition of these intermediate alloys to the melted magnesium alloy necessarily results in a mixture of the additive material and magnesium alloy. Id. at ¶ 111.
said additive material constituting about 0.05-45 wt % of said mixture,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1. And Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials

	aluminum-iron with 30 wt% iron, aluminum- nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao.
said additive material includes one or more metals selected from the group consisting of copper, nickel, titanium, iron, and cobalt,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said magnesium composite including in situ precipitation of galvanically-active	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion

intermetallic phases that include said additive material,	performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro- batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. As Dr. Medlin explains, a POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 256. As noted above, at least Fe, Cu, and Ni are "additive materials." Consequently, the in-situ precipitation of galvanically- active intermetallic phases will include one or more of these additive materials. Thus, Xiao discloses all of these claim limitations.
said additive material located in sufficient quantities in said galvanically-active intermetallic phases so as to obtain a composition and morphology of said galvanically-active intermetallic phases such that a galvanic corrosion rate along said galvanically-active intermetallic phases causes said magnesium composite to have a dissolution rate of at least at	A POSITA would understand that the galvanically-active intermetallic phases ("composite micro-particles") have a morphology that enhances the corrosion dissolution rate of the alloy due to a larger number of smaller particles throughout the microstructure. Medlin Decl. Exhibit 2 at ¶ 229. A POSITA would also understand the relationship between "composite micro-particles" and morphology of the galvanically-active intermetallic phases. Id. With respect to the "sufficient quantities" limitation, other claim limitations in Claims 49 and 73, define the weight percentage for the additive material as 0.05-45 wt% and about 0.05 wt%, respectively, which limitations are met by the teaching of Xiao with respect to four metals. In particular, Xiao discloses that "[e]lements such as Fe, Cu, Ni, Ag, etc., in the

least 5 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	magnesium alloy can form a large number of intermetallic composite micro-particles, which can improve the corrosion performance of the magnesium alloy, thereby promoting the decomposition of the magnesium alloy." Id. ¶ 0026. And the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%;..." Id. at Claim 2. As such, Xiao discloses four metals (i.e., Fe, Cu, Ni, and Ti) included within the list of "additive material" set forth in Claim Element M, supra. The claimed weight % quantities of the "additive material" of Claim Element I, supra, also overlap with the weight % ranges of Xiao's "trace elements". As such, Claim Element P of claims 49 and 73-- that the "additive materials" are located in "sufficient quantities"--is fully disclosed by Xiao's Claim 2 disclosure of "trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%..." Id. As such, Xiao's four metal "trace elements" are present in "sufficient quantities" to meet Claim Element P of claims 49 and 73. A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130.

	Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate of at least three times the claimed "at least 5 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "at least of 5 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 50	**Disclosure of Claim Element in Xiao**
50. The magnesium composite as defined in claim 49, wherein said additive material includes one or more metals selected from the group consisting of copper, nickel, and cobalt.	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper and nickel, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper and nickel, and hence fully discloses all of the limitations of these claim elements.
Dependent Claim 52	**Disclosure of Claim Element in Xiao**
52. The magnesium composite as defined in claim 49, wherein said magnesium alloy includes over 50 wt % magnesium, and one or more metals selected from the	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)).

group consisting of aluminum, boron, bismuth, zinc, zirconium, and manganese.	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed range.
Dependent Claim 53	**Disclosure of Claim Element in Xiao**
53. The magnesium composite as defined in claim 49, wherein said magnesium alloy includes over 50 wt % magnesium, and one or more metals selected from the group consisting of aluminum in an amount of about 0.5-10 wt %, zinc in an amount of about 0.1-6 wt %, zirconium in an amount of about 0.01-3 wt %, manganese in an amount of about 0.15-2 wt %, boron in an amount of about 0.0002-0.04 wt %, and bismuth in amount of about 0.4-0.7 wt %.	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements. This claim element would be anticipated solely by the zirconium concentrations falling within the 0.01-6 wt% range. Claim 3 also requires, in addition to a similar zirconium concentration to the Markush claims, a zinc concentration of 0.1-3 wt%.

Dependent Claim 54	Disclosure of Claim Element in Xiao
54. The magnesium composite as defined in claim 49, wherein said magnesium alloy includes over 50 wt % magnesium, and one or more metals selected from the group consisting of aluminum in an amount of about 0.5-10 wt %, zinc in an amount of about 0.1-3 wt %, zirconium in an amount of about 0.01-1 wt %, manganese in an amount of about 0.15-2 wt %, boron in an amount of about 0.0002-0.04 wt %, and bismuth in an amount of about 0.4-0.7 wt %.	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements. This claim element would be anticipated solely by the zirconium concentrations falling within the 0.01-6 wt% range. Claim 3 also requires, in addition to a similar zirconium concentration to the Markush claims, a zinc concentration of 0.1-3 wt%.
Dependent Claim 56	**Disclosure of Claim Element in Xiao**
56. The magnesium composite as defined in claim 49, wherein said magnesium alloy includes 60-95 wt % magnesium and 0.01-1 wt % zirconium.	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps

	and covers much of the claimed ranges set forth in these claim elements. Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao.
Dependent Claim 57	**Disclosure of Claim Element in Xiao**

57. The magnesium composite as defined in claim 56, wherein said magnesium alloy further includes 0.05-6 wt % zinc.	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements. Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel

	additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao.
Dependent Claim 58	**Disclosure of Claim Element in Xiao**
58. The magnesium composite as defined in claim 49, wherein said magnesium alloy includes 60-95 wt % magnesium, 0.5-10 wt % aluminum, 0.05-6 wt % zinc, and 0.15-2 wt % manganese.	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements. Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in

	association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao.
Dependent Claim 59	**Disclosure of Claim Element in Xiao**
59. The magnesium composite as defined in claim 49, wherein said magnesium alloy includes over 50 wt % magnesium and one or more metals selected from the group consisting of 0.5-10 wt % aluminum, 0.1-2 wt % zinc, 0.01-1 wt % zirconium, and 0.15-2 wt % manganese.	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps

	and covers much of the claimed ranges set forth in these claim elements. Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao.
Dependent Claim 60	**Disclosure of Claim Element in Xiao**

60. The magnesium composite as defined in claim 49, wherein said magnesium alloy includes over 50 wt % magnesium, and one or more metals selected from the group consisting of 0.1-3 wt % zinc, 0.01-1 wt % zirconium, 0.05-1 wt % manganese, 0.0002-0.04 wt % boron, and 0.4-0.7 wt % bismuth.	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements. Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel

	additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao.
Dependent Claim 61	**Disclosure of Claim Element in Xiao**
61. The magnesium composite as defined in claim 49, wherein said additive material includes nickel,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including nickel, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including nickel, and hence fully discloses all of the limitations of these claim elements.
said nickel constitutes about 0.05-35 wt % of said magnesium composite,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the

	weight percentages of the components is 100%." Xiao at Claim 1. And Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, this claim element was disclosed by Xiao.
said nickel forms galvanically-active in situ	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion

precipitate in said magnesium composite.	performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 62	**Disclosure of Claim Element in Xiao**
62. The magnesium composite as defined in claim 61, wherein said nickel	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim

constitutes about 3-7 wt % of said magnesium composite.	1. And Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, this claim element was disclosed by Xiao.
Dependent Claim 64	**Disclosure of Claim Element in Xiao**

64. The magnesium composite as defined in claim 49, wherein said additive material includes copper,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, and hence fully discloses all of the limitations of this claim element.
said copper constitutes about 0.05-35 wt % of said magnesium composite,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1. And Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in

	association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum- nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, this claim element is disclosed by Xiao.
said copper forms the galvanically-active in situ precipitate in said magnesium composite.	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id.

	These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 66	**Disclosure of Claim Element in Xiao**
66. The magnesium composite as defined in claim 49, wherein a dissolution rate of said magnesium composite is about 5-325 mg/cm2/hr. in 3 wt % KCI water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate within the claimed range of "about 5-325 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "about 5" mg/cm2/hr at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 67	**Disclosure of Claim Element in Xiao**
67. The magnesium composite as defined in claim 49, wherein a dissolution rate of said magnesium composite is at least 45 mg/cm2/hr. in 3 wt % KCl water mixture at	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064.

90°C. and up to 325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Six of the seven examples (excluding the comparative [prior art] example) provided in Xiao therefore discloses a dissolution rate of "at least 45 mg/cm2/hr in 3 wt % KCl water" and "up to 325 mg/cm2/hr in 3 wt % KCl water" at 93°C. Given that the dissolution rates of Xiao slightly above (i.e., 3°C above) 90°C are almost all above the claimed floor of "at least 45 mg/cm2/hr". As such and per Dr. Medlin's opinion, a POSITA in April 2014 would have expected the dissolution rate of the examples in Xiao at 90°C to also be necessarily above the claimed floor of "at least 45 mg/cm2/hr." Medlin Decl. Exhibit 2 at ¶ 205. Thus, this element is disclosed by Xiao.
Dependent Claim 69	**Disclosure of Claim Element in Xiao**
69. The magnesium composite as defined in claim 49, wherein said additive material has a melting point temperature that is 100°C. greater than a melting temperature of said magnesium or magnesium alloy.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). As Dr. Medlin opines, a POSITA in April 2014 would have understood "melting temperature" in this claim element to be a reference to the smelting temperature or temperature of the melt when the additive material is being added to the magnesium or magnesium alloy, not the "melting point temperature" as that measurement is used for the additive material. Medlin Decl. Exhibit 2 at ¶ 235. Xiao generally discloses "loading pure magnesium and pure aluminum into a smelting furnace and increasing the

	temperature to 700 to 730 °C, next loading pure zinc and an [sic] intermediate alloys . . . into a resulting magnesium-aluminum alloy melt after melting and increasing the temperature to 740 to 780°C . . . ." Xiao at ¶¶ 0021–0022; see also Id. at Claim 5 ("the melting temperature of the pure magnesium and pure aluminum is from 700 to 730 °C.") Examples 1–7 of Xiao teach a range of smelting temperatures for the magnesium-aluminum alloy from 700°C (Example 1) to 730°C (Examples 2, 5, and 7). Xiao ¶¶ 0034–0060. The additive materials noted above are one or more of the intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ag, Al-Zr, Al-Ti. Id. at ¶ 0023. A POSITA using typical phase diagrams for each of these additive materials would be able to readily determine the melting point temperature. Medlin Decl. Exhibit 2, e.g., at ¶ ¶ 50- 52. Dr. Medlin reviewed phase diagrams and opined that a POSITA in April 2014 would have recognized that Al-Fe had a variable melting point temperature ranging from 1538°C (pure iron) down to 652°C for a eutectic point near 99 wt% aluminum; Al-Ni had a variable melting point temperature that ranges from 1640°C down to 640°C (depending upon the alloy mixture); and Al-Cu had a variable melting point temperature ranging from 548°C up to 1084°C (depending upon the alloy mixture). Medlin Decl. Exhibit 2 at ¶ 239. Example 7 of Xiao specifically discloses a melting or smelting temperature of 730°C. Xiao at ¶ 0060. Dr. Medlin specifically analyzed Example 7 of Xiao to determine (using particular intermediate alloy compositions) the melting point temperatures of the intermediate alloys added. Medlin Decl. Exhibit 2 at ¶ 240. It is thus Dr. Medline's opinion that a POSITA in April 2014 would have recognized from Example 7

	of Xiao that at least an aluminum-nickel additive having 45 wt% nickel has a melting point temperature of 854°C which is 100°C greater than the melting or smelting temperatures of the magnesium aluminum alloy used in Example 7 (i.e., 730°C) and otherwise taught generally by Xiao (i.e., 700-730°C). Id. at ¶ 381. A POSITA in April 2014 would have also recognized that other intermediate alloy compositions could have fallen within the teachings of Example 7 and other disclosures of Xiao and resulted in Al-Fe, Al-Ni, and Al-Cu intermediate alloys that would have had melting point temperatures that were 100°C. greater than the smelting temperatures of the magnesium alloy generally taught by Xiao (i.e., 700- 730°C). Id. Thus, this claim element was disclosed by Xiao.
Dependent Claim 70	**Disclosure of Claim Element in Xiao**
70. The magnesium composite as defined in claim 49, wherein said magnesium composite is at least partially included in a down hole well component,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao discloses that the cast magnesium alloy "can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique." ¶ 0001. A POSITA would have understood that a tripping ball was a type of tool component in an oil well drilling operation. Medlin Decl. Exhibit 2 at ¶ 148. Thus, these claim elements were disclosed by Xiao.
said down hole well component including one or more components selected from the group consisting of a sleeve, frac ball, hydraulic	Xiao discloses that the cast magnesium alloy "can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique." Xiao at ¶ 0001. A POSITA would have understood that a tripping ball was a type of tool component in an oil well drilling operation. Medlin Decl. Exhibit 2 at ¶ 148.

actuating tooling, tube, valve, valve component, or plug.	
Dependent Claim 72	**Disclosure of Claim Element in Xiao**
72. The magnesium composite as defined in claim 49, wherein said additive material is a metal or metal alloy.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these additive materials contain metal(s). Medlin Decl. Exhibit 2 at ¶ 145. Accordingly, Example 7 of Xiao discloses this claim element in accordance with Patent Owner's definition of "additive material."
Independent Claim 73	**Disclosure of Claim Element in Xiao**
73. A dissolvable magnesium composite for use in a ball or other tool component in a well drilling or completion operation,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao discloses that the cast magnesium alloy "can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique." ¶ 0001. A POSITA would have understood that a tripping ball was a type of tool component in

	an oil well drilling operation. Medlin Decl. Exhibit 2 at ¶ 148. Thus, these claim elements were disclosed by Xiao.
said dissolvable magnesium composite includes in situ precipitation of galvanically-active intermetallic phases to enable controlled dissolution of said magnesium composite,	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Xiao at ¶ 0026. A POSITA in August 2014 would have understood this disclosure in Xiao (¶ 0026) of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108.
said magnesium composite comprising a mixture of magnesium or a magnesium alloy and an additive material,	Xiao discloses "first loading pure magnesium and pure aluminum into a smelting furnace . . . next loading pure zinc and an [sic] intermediate alloys of trace element components into a resulting magnesium-aluminum alloy melt after melting." Xiao, at ¶ 0022. Xiao discloses that "Al-Fe ... Al-Ni ... Al-Cu ... Al-Ag ... Al-Zr ... and ... Al-Ti intermediate alloy[s], are heated to

	dry and then added to the magnesium-aluminum alloy melt." Id. at ¶ 0023. These intermediate alloys meet the Patent Owner's definition of "additive material," i.e., "a material that is added." Medlin Decl. Exhibit 2, at ¶ 110. The addition of these intermediate alloys to the melted magnesium alloy necessarily results in a mixture of the additive material and magnesium alloy. Id. at ¶ 111.
said additive material constituting about 0.05 wt % of said mixture,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1. And Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum- nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-

	copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao.
said additive material is a metal or metal alloy,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these additive materials contain metal(s). Medlin Decl. Exhibit 2 at ¶ 145. Accordingly, Example 7 of Xiao discloses this claim element in accordance with Patent Owner's definition of "additive material."
said additive material includes one or more metals selected from the group consisting of copper, nickel, titanium, iron, silicon, and cobalt,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses

	intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said magnesium composite including in situ precipitation of galvanically-active intermetallic phases that include said additive material,	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro- batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. As Dr. Medlin explains, a POSITA in August 2014 would have understood this disclosure in Xiao of "intermetallic composite micro-particles" (¶ 0026) to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 256. As noted above, at least Fe, Cu, and Ni are "additive materials." Consequently, the in-situ precipitation of galvanically- active intermetallic phases will include one or more of these additive materials. Thus, Xiao discloses all of these claim limitations.
said additive material located in sufficient quantities in said galvanically-active	A POSITA would understand that the galvanically-active intermetallic phases ("composite micro-particles") have a morphology that enhances the corrosion dissolution rate of the

intermetallic phases so as to obtain a composition and morphology of said galvanically-active intermetallic phases such that a galvanic corrosion rate along said galvanically-active intermetallic phases causes said magnesium composite to have a dissolution rate of at least at least 5 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	alloy due to a larger number of smaller particles throughout the microstructure. Medlin Decl. Exhibit 2 at ¶ 229. A POSITA would also understand the relationship between "composite micro-particles" and morphology of the galvanically-active intermetallic phases. Id. With respect to the "sufficient quantities" limitation, other claim limitations in Claims 49 and 73 define the weight percentage for the additive material as 0.05-45 wt% and about 0.05 wt%, respectively, which limitations are met by the teaching of Xiao with respect to four metals. In particular, Xiao discloses that "[e]lements such as Fe, Cu, Ni, Ag, etc., in the magnesium alloy can form a large number of intermetallic composite micro-particles, which can improve the corrosion performance of the magnesium alloy, thereby promoting the decomposition of the magnesium alloy." Id. ¶ 0026. And the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%;..." Id. at Claim 2. As such, Xiao discloses four metals (i.e., Fe, Cu, Ni, and Ti) included within the list of "additive material" set forth in Claim Element M, supra. The claimed weight % quantities of the "additive material" of Claim Element I, supra, also overlap with the weight % ranges of Xiao's "trace elements". As such, Claim Element P of claims 49 and 73-- that the "additive materials" are located in "sufficient quantities"--is fully disclosed by Xiao's Claim 2 disclosure of "trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%..." Id. As such, Xiao's four metal "trace elements" are present in "sufficient quantities" to meet Claim Element P of claims 49 and 73.

	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate of at least three times the claimed "at least 5 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "at least of 5 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.

A. Ground II: Claims 8, 25–28, 33–36, 55, and 74–76 are anticipated, or at least made obvious, by Xiao

i. Anticipation and/or Single-Reference Obviousness

Claims 8, 25, 33, 55, and 74 each contain at least one limitation that, if not outright disclosed by Xiao, is "almost" disclosed by Xiao, or it is disclosed by combining the prior art disclosed in Xiao with the teachings of Xiao. However, for anticipation a prior art reference must "disclose all elements of the claim within the four corners of the document," and it must "disclose those elements 'arranged as in the claim.'" *NetMoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359,

1369 (Fed. Cir. 2008) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983)). Still, a reference can anticipate a claim even if it "'does not expressly spell out' all the limitations arranged or combined as in the claim, if a person of skill in the art, reading the reference, would 'at once envisage' the claimed arrangement or combination." *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015) (quoting *In re Petering*, 301 F.2d 676, 681 (CCPA)). Moreover, a disclosure that anticipates also renders the claim invalid because "anticipation is the epitome of obviousness." *Connell*, 722 F.2d at 1548 (quoting *In re Fracalossi*, 681 F.2d 792, 794 (CCPA)). Thus, "a prior art disclosure that 'almost' meets the standard may render the claim invalid under § 103; it does not 'anticipate.'" *Id.* With respect to the Challenged Claims of Ground II, if Xiao does not explicitly fully disclose the remaining elements of these claims (as addressed below), it almost does and, thus, renders each of those claims invalid as obvious.

ii. Independent Claims 25, 33, and 74 and Dependent Claims 8, 26–28, 34–36, 55, and 75–76 are anticipated, or at least made obvious, by Xiao

'653 Patent Claims/Elements	**Anticipated, Or at Least Made Obvious, by Disclosures of CN 103343271 A Xiao et al. ("Xiao") and Prior Art Magnesium Disclosed in Xiao**
Dependent Claim 8	**Disclosure of Claim Element in Xiao and/or Prior Art Magnesium Disclosed in Xiao**
8. The magnesium composite as defined in claim 1, wherein said magnesium composite is subjected to a surface treatment to improve a surface hardness of said magnesium composite,	As set forth in Ground I, supra, Xiao already discloses each and every element of the magnesium composition of Claim 1. Xiao does not claim, nor disclose in any novel embodiment, subjecting any of its novel magnesium composites to surface treatments (i.e. peening, heat treatment, aluminizing or combinations thereof) nor does it teach that surface treatment

	would achieve any of the benefits set forth in Claim 8 of the '653 Patent. However, Xiao discloses that a U.S. Patent Publication teaches a method "for preparing a composite material having a decomposable multilayer coated core-shell structure (U.S. Patent No. US2011/0132143A1, 2011). ¶ 0002. It is explicitly noted in Xiao that this U.S. patent publication discloses an electroless plating process applied on the surface of particles of nanoscale core metal powders (such as magnesium, aluminum, zinc, manganese and alloys thereof) to coat multiple layers of a nano-shell of different metals or metal oxides, such as Al, Ni, Al2O3, and the like, and then the composite powder is sintered to form a nanocomposite material having certain decomposition feature [sic]." Id. A POSITA in April 2014 would have understood that this sintering process discussed within Xiao was a well-known type of surface treatment that can be used to improve the surface hardness of the sintered metal. See also, e.g., Ex. 1203 ("Powder metal technology is well known to the persons skilled in the art and generally comprises the formation of metal powders which are compacted and then subjected to an elevated temperature so as to produce a sintered product."). Consequently, Xiao teaches a magnesium composite subjected to a heat treating surface treatment to improve surface hardness of the magnesium.
said surface treatment including peening, heat treatment, aluminizing, or combinations thereof.	As set forth in Ground I, supra, Xiao already discloses each and every element of the magnesium composition of Claim 1. Xiao does not claim, nor disclose in any novel embodiment, subjecting any of its novel magnesium composites to surface treatments (i.e. peening, heat treatment, aluminizing or combinations thereof) nor does it teach that surface treatment

	would achieve any of the benefits set forth in Claim 8 of the '653 Patent. However, Xiao discloses that a U.S. Patent Publication teaches a method "for preparing a composite material having a decomposable multilayer coated core-shell structure (U.S. Patent No. US2011/0132143A1, 2011). ¶ 0002. It is explicitly noted in Xiao that this U.S. patent publication discloses an electroless plating process applied on the surface of particles of nanoscale core metal powders (such as magnesium, aluminum, zinc, manganese and alloys thereof) to coat multiple layers of a nano-shell of different metals or metal oxides, such as Al, Ni, Al2O3, and the like, and then the composite powder is sintered to form a nanocomposite material having certain decomposition feature [sic]." Id. A POSITA in April 2014 would have understood that this sintering process discussed within Xiao was a well-known type of surface treatment that can be used to improve the surface hardness of the sintered metal. See also, e.g., Ex. 1203 ("Powder metal technology is well known to the persons skilled in the art and generally comprises the formation of metal powders which are compacted and then subjected to an elevated temperature so as to produce a sintered product."). Consequently, Xiao teaches a magnesium composite subjected to a heat treating surface treatment to improve surface hardness of the magnesium.
Independent Claim 25	**Disclosure of Claim Element in Xiao and/or Prior Art Magnesium Disclosed in Xiao**
25. A dissolvable magnesium alloy composite for use in a ball or other tool component	Xiao discloses that the cast magnesium alloy "can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique." ¶ 0001. A POSITA would have

in a well drilling or completion operation,	understood that a tripping ball was a type of tool component in an oil well drilling operation. Medlin Decl. Exhibit 2 at ¶ 148.
said dissolvable magnesium alloy composite comprising at least 85 wt % magnesium;	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao (emphasis added). Dr. Medlin opines that a POSITA would have understood that the range of non-magnesium elements in Claim 1 leaves 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Thus, Xiao discloses a range of magnesium up to 85 wt%, which touches the claimed range (i.e. at least 85 wt% magnesium) set forth in this claim element. However, this leaves no room for any of the claimed additive materials. Xiao also discloses a prior art magnesium alloy represented by Mg-Al-Zn (with AZ91D magnesium alloy being the most widely used) wherein the "main components of this alloy and the respective weight percentages are as follows: Al 8.3 to 9.7, Zn 0.35 to 1.0, Mn 0.15 to 0.5, and the remainder [(i.e. 88.8 to 91.2 wt%)] is magnesium." Id. at ¶ 0003; Medlin Decl. Exhibit 2 at ¶ 269. Xiao also uses an AZ91D as a comparative example alloy, with a composition of 9 wt% Al, 1 wt% Zn, 0.3 wt% Zr, and 0.1 wt% Mn, with the remainder (i.e. 89.6 wt%) being magnesium. Id. at ¶ 0032. Xiao teaches a primary difference between this prior art and its novel magnesium alloy lies in the addition of metallic elements like Iron, Copper, and/or Nickel into the alloy. Id. at ¶ 0026 ("[e]lements such as Fe, Cu, Ni, Ag, etc., in the magnesium alloy can form a large number of intermetallic composite micro-particles, which can improve the corrosion performance of the magnesium alloy, thereby promoting the decomposition of the magnesium alloy"). The dissolution data in Xiao (Xiao at ¶ 0061) teaches that the

	addition of Iron, Copper, and/or Nickel (alongside the Aluminum, Zinc, Zirconium, and Manganese of the prior art AZ91D example) caused a surprisingly large increase in dissolution rates. Thus, Xiao, as a whole, teaches magnesium compositions with magnesium content above 85 wt% and "room" for the novel additive materials (i.e. "Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%" (Xiao at Claim 2)). Thus, Xiao fully discloses a range of magnesium of at least 85 wt %, touching and even overlapping the claimed range.
one or more metals selected from the group consisting of 0.5-10 wt % aluminum, 0.05-6 wt % zinc, 0.01-3 wt % zirconium, and 0.15-2 wt % manganese; and about 0.05-45 wt % of a secondary metal to form a galvanically-active intermetallic particle that promotes corrosion of said dissolvable magnesium alloy composite,	This claim element would be anticipated solely by the zirconium concentrations falling within the 0.01-3 wt% range. Claim 25 also requires, in addition to a similar zirconium concentration to the Markush claims, a zinc concentration of 0.05-6 wt%. Claim 1 of Xiao discloses "Al: 13 to 25%, Zn: 2 to 15%," and Claim 2 of Xiao discloses secondary metals of "Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Thus, Xiao teaches 0.05-0.5 wt% zirconium, which touches and covers at least a portion of these claimed ranges. Medlin Decl. Exhibit 2 ¶ 150. Xiao similarly teaches 2-15 wt% zinc, which covers much of the claimed (0.05-6 wt%) zinc concentration. Id. at ¶ ¶ 167-68. A claim is invalid as anticipated when it is in Markush form and a prior art reference disclosed one of the claimed elements. See Fresenius USA, Inc. v. Baxter Int'l, Inc., 582 F.3d 1288, 1298 (Fed. Cir. 2009). See also Abbott Labs. v. Baxter Pharm. Prods., Inc., 334 F.3d 1274, 1280 (Fed.Cir.2003); Schering Corp. v. Geneva Pharms., Inc., 339 F.3d 1373, 1380 (Fed.Cir.2003);

	These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum- nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, this claim element was disclosed by Xiao.
said secondary metal including one or more metals selected from the group consisting of copper, nickel, cobalt, titanium and iron,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate

	alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said magnesium alloy composite has a dissolution rate of at least 5 mg/cm2/hr. in 3 wt % KCI water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate of at least three times the claimed "at least 5 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "at least of 5 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 26	**Disclosure of Claim Element in Xiao and/or Prior Art Magnesium Disclosed in Xiao**
26. The dissolvable magnesium alloy composite as defined in claim 25, wherein a dissolution rate of	As the discussion, supra, demonstrates, the novel examples explicitly analyzed in Xiao disclose dissolution rates only up to 74 mg/cm2/hr in 3 wt.% KCl water at 93°C, shy of this claimed

said magnesium alloy composite is 100-325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	range. Medlin Decl. Exhibit 2 at ¶ 330. However, Dr. Medlin opines that a POSITA in April 2014 would have understood Xiao to also teach dissolution rates above that floor at 90°C, because (1) the dissolution rates in the Xiao examples are very close to the claimed floor (e.g. Example 1 exhibited a rate of 74 mg/cm2/hr at 93°C, Example 6 a rate of 63 mg/cm2/hr at 90°C, and Example 7 a rate of 57 mg/cm2/hr at 93°C; and (2) a POSITA would have expected that other magnesium compositions having additive amounts in the ranges as disclosed by Xiao, but with higher amounts of copper, nickel, and/or iron than the amounts tested by Xiao's examples would have improved corrosion performance. Medlin Decl. Exhibit 2 at ¶ 331. In particular, even though they come close to the 100 mg/cm2/hr at 90°C, Examples 1, 6 and 7 of Xiao had less aggregate copper, nickel and iron than taught by Claim 2 of Xiao (i.e. 5 wt% for each of copper, nickel, and iron in a magnesium composite). Medlin Decl. Exhibit 2 at ¶ 331. Thus, the Examples in Xiao used lower amounts of these specific dissolution-enhancing additive elements. Thus, according to Dr. Medlin, a POSITA in April 2014 would have understood this and recognized that Xiao teaches magnesium compositions having dissolution rates above the claimed floor. Dr. Medlin also notes that it was well-known prior to April 2014 that additions of copper, iron, nickel and cobalt cause a sharp linear increase in the corrosion rate of magnesium as evidenced by Shaw, "Corrosion Resistance of Magnesium Alloys" published in 2003 in the ASM Handbook, Vol. 13A (2003). Ex. 1204. Medlin Decl. Exhibit 2 at ¶ 332. As such, the recitation of the claimed dissolution rate of 100-325 mg/cm2/hr at 90°C was not a new property or use but rather a property that would

	be inherent in the compositions disclosed in Xiao, as confirmed by the extrinsic evidence of Shaw.
Dependent Claim 27	**Disclosure of Claim Element in Xiao and/or Prior Art** **Magnesium Disclosed in Xiao**
27. The dissolvable magnesium composite as defined in claim 25, wherein said secondary metal includes nickel,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including nickel, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including nickel, and hence fully discloses all of the limitations of these claim elements.
said nickel forms galvanically-active in situ precipitate in said magnesium composite.	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the

	grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 28	**Disclosure of Claim Element in Xiao and/or Prior Art** **Magnesium Disclosed in Xiao**
28. The dissolvable magnesium alloy composite as defined in claim 25, wherein said additive material is a metal or metal alloy.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these additive materials contain metal(s). Medlin Decl. Exhibit 2 at ¶ 145. Accordingly, Example 7 of Xiao discloses this claim element in accordance with Patent Owner's definition of "additive material."
Independent Claim 33	**Disclosure of Claim Element in Xiao and/or Prior Art** **Magnesium Disclosed in Xiao**
33. A dissolvable magnesium alloy composite for use in a ball or other tool component	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9.

in a well drilling or completion operation,	See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶¶ 104-105 (Claim 1)). Xiao discloses that the cast magnesium alloy "can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique." ¶ 0001. A POSITA would have understood that a tripping ball was a type of tool component in an oil well drilling operation. Medlin Decl. Exhibit 2 at ¶ 148.
said dissolvable magnesium alloy composite comprising 60-95 wt % magnesium; 0.5-10 wt % aluminum; 0.05-6 wt % zinc; 0.15-2 wt % manganese; and about 0.05-45 wt % of a secondary metal	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements. Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage

	(ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum- nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao. Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao (emphasis added). Dr. Medlin opines that a POSITA would have understood that the range of non-magnesium elements in Claim 1 leaves 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Thus, Xiao discloses a range of magnesium up to 85 wt%, which touches the claimed range (i.e. at least 85 wt% magnesium) set forth in these claim elements. However, this leaves no room for any of the claimed additive materials. Xiao also discloses a prior art magnesium alloy represented by Mg-Al-Zn (with AZ91D magnesium alloy being the most widely used) wherein the "main components of this alloy and

	the respective weight percentages are as follows: Al 8.3 to 9.7, Zn 0.35 to 1.0, Mn 0.15 to 0.5, and the remainder [(i.e. 88.8 to 91.2 wt%)] is magnesium." Id. at ¶ 0003; Medlin Decl. Exhibit 2 at ¶ 269. Xiao also uses an AZ91D as a comparative example alloy, with a composition of 9 wt% Al, 1 wt% Zn, 0.3 wt% Zr, and 0.1 wt% Mn, with the remainder (i.e. 89.6 wt%) being magnesium. Id. at ¶ 0032. Xiao teaches a primary difference between this prior art and its novel magnesium alloy lies in the addition of metallic elements like Iron, Copper, and/or Nickel into the alloy. Id. at ¶ 0026 ("[e]lements such as Fe, Cu, Ni, Ag, etc., in the magnesium alloy can form a large number of intermetallic composite micro-particles, which can improve the corrosion performance of the magnesium alloy, thereby promoting the decomposition of the magnesium alloy"). The dissolution data in Xiao (Xiao at ¶ 0061) teaches that the addition of Iron, Copper, and/or Nickel (alongside the Aluminum, Zinc, Zirconium, and Manganese of the prior art AZ91D example) caused a surprisingly large increase in dissolution rates. Thus, Xiao, as a whole, teaches magnesium compositions with magnesium content above 85wt% and "room" for the novel additive materials (i.e. "Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%" (Xiao at Claim 2)). Thus, Xiao fully discloses a range of magnesium of at least 85 wt %, touching and even overlapping the claim range.
to form a galvanically-active intermetallic particle that promotes corrosion of said dissolvable magnesium alloy composite,	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in

	terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro- batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
said secondary metal including one or more metals selected from the group consisting of copper, nickel, cobalt, titanium and iron,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel,

	and iron, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said magnesium alloy composite has a dissolution rate of at least 5 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate of at least three times the claimed "at least 5 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "at least of 5 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 34	**Disclosure of Claim Element in Xiao and/or Prior Art** **Magnesium Disclosed in Xiao**
34. The dissolvable magnesium alloy composite as defined in claim 33, wherein a dissolution rate of said magnesium alloy	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2

composite is 5-325 mg/cm'/hr. in 3 wt % KCl water mixture at 90°C.	at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate within the claimed range of of at least three times the claimed "about 5-325 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "about 5" "about 5-325 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132.
Dependent Claim 35	**Disclosure of Claim Element in Xiao and/or Prior Art** **Magnesium Disclosed in Xiao**
35. The dissolvable magnesium composite as defined in claim 33, wherein said secondary metal includes nickel,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti

	and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including nickel, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including nickel, and hence fully discloses all of the limitations of these claim elements.
said nickel forms galvanically-active in situ precipitate in said magnesium composite.	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao.

	These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 36	**Disclosure of Claim Element in Xiao and/or Prior Art Magnesium Disclosed in Xiao**
36. The dissolvable magnesium alloy composite as defined in claim 33, wherein said additive material is a metal or metal alloy.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these additive materials contain metal(s). Medlin Decl. Exhibit 2 at ¶ 145. Accordingly, Example 7 of Xiao discloses this claim element in accordance with Patent Owner's definition of "additive material."
Dependent Claim 55	**Disclosure of Claim Element in Xiao and/or Prior Art Magnesium Disclosed in Xiao**
55. The magnesium composite as defined in claim 49, wherein said magnesium alloy includes at least 85 wt % magnesium, and one or	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)).

more metals selected from the group consisting of 0.5-10 wt % aluminum, 0.05-6 wt % zinc, 0.01-3 wt % zirconium, and 0.15-2 wt % manganese.	This claim element would be anticipated solely by the zirconium concentrations falling within the 0.01-3 wt% range. Claim 55 also requires, in addition to a similar zirconium concentration to the Markush claims, a zinc concentration of 0.05-6 wt%. Claim 1 of Xiao discloses "Al: 13 to 25%, Zn: 2 to 15%," and Claim 2 of Xiao discloses secondary metals of "Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Thus, Xiao teaches 0.05-0.5 wt% zirconium, which touches and covers at least a portion of these claimed ranges. Medlin Decl. Exhibit 2 ¶ 150. Xiao similarly teaches 2-15 wt% zinc, which covers much of the claimed (0.05-6 wt%) zinc concentration. Id. at ¶ ¶ 167-68. A claim is invalid as anticipated when it is in Markush form and a prior art reference disclosed one of the claimed elements. See Fresenius USA, Inc. v. Baxter Int'l, Inc., 582 F.3d 1288, 1298 (Fed. Cir. 2009). See also Abbott Labs. v. Baxter Pharm. Prods., Inc., 334 F.3d 1274, 1280 (Fed.Cir.2003); Schering Corp. v. Geneva Pharms., Inc., 339 F.3d 1373, 1380 (Fed.Cir.2003); Thus, Xiao teaches all of these claim limitations. Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao (emphasis added). Dr. Medlin opines that a POSITA would have understood that the range of non-magnesium elements in Claim 1 leaves 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Thus, Xiao discloses a range of magnesium up to 85 wt%, which touches the claimed range (i.e. at least 85

	wt% magnesium) set forth in these claim elements. However, this leaves no room for any of the claimed additive materials. Xiao also discloses a prior art magnesium alloy represented by Mg-Al-Zn (with AZ91D magnesium alloy being the most widely used) wherein the "main components of this alloy and the respective weight percentages are as follows: Al 8.3 to 9.7, Zn 0.35 to 1.0, Mn 0.15 to 0.5, and the remainder [(i.e. 88.8 to 91.2 wt%)] is magnesium." Id. at ¶ 0003; Medlin Decl. Exhibit 2 at ¶ 269. Xiao also uses an AZ91D as a comparative example alloy, with a composition of 9 wt% Al, 1 wt% Zn, 0.3 wt% Zr, and 0.1 wt% Mn, with the remainder (i.e. 89.6 wt%) being magnesium. Id. at ¶ 0032. Xiao teaches a primary difference between this prior art and its novel magnesium alloy lies in the addition of metallic elements like Iron, Copper, and/or Nickel into the alloy. Id. at ¶ 0026 ("[e]lements such as Fe, Cu, Ni, Ag, etc., in the magnesium alloy can form a large number of intermetallic composite micro-particles, which can improve the corrosion performance of the magnesium alloy, thereby promoting the decomposition of the magnesium alloy"). The dissolution data in Xiao (Xiao at ¶ 0061) teaches that the addition of Iron, Copper, and/or Nickel (alongside the Aluminum, Zinc, Zirconium, and Manganese of the prior art AZ91D example) caused a surprisingly large increase in dissolution rates. Thus, Xiao, as a whole, teaches magnesium compositions with magnesium content above 85wt% and "room" for the novel additive materials (i.e. "Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%" (Xiao at Claim 2)). Thus, Xiao fully discloses a range of magnesium of at least 85 wt %, touching and even overlapping the claim range.

	As for the other requirements of dependent claim 55, it has already been established in Ground I that Xiao discloses each and every element of independent claim 49. Ground I also establishes that Xiao discloses at least three of the metals overlapping the weight percentage ranges required by the Markush element of dependent claim 55 (i.e., 0.5-10 wt% aluminum, 0.05-6wt% zinc, and/or 0.01-3 wt% zirconium).
Independent Claim 74	**Disclosure of Claim Element in Xiao and/or Prior Art Magnesium Disclosed in Xiao**
74. A dissolvable magnesium composite for use in a ball or other tool component in a well drilling or completion operation,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. See Declaration of Dr. Dana Medlin (Medlin Decl. Exhibit 2, e.g., at ¶ 104-105 (Claim 1)). Xiao discloses that the cast magnesium alloy "can be used as a tripping ball material for a multi-stage sliding sleeve staged-fracturing technique." Xiao at ¶ 0001. A POSITA would have understood that a tripping ball was a type of tool component in an oil well drilling operation. Medlin Decl. Exhibit 2 at ¶ 148. Thus, these claim elements were disclosed by Xiao.
said dissolvable magnesium composite includes in situ precipitation of galvanically-active intermetallic phases to enable controlled dissolution of said magnesium composite,	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of

	micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Xiao at ¶ 0026. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao.
said magnesium composite comprising a mixture of magnesium or a magnesium alloy and an additive material,	Xiao discloses "first loading pure magnesium and pure aluminum into a smelting furnace . . . next loading pure zinc and an [sic] intermediate alloys of trace element components into a resulting magnesium-aluminum alloy melt after melting." Xiao, at ¶ 0022. Xiao discloses that "Al-Fe ... Al-Ni ... Al-Cu ... Al-Ag ... Al-Zr ... and ... Al-Ti intermediate alloy[s], are heated to dry and then added to the magnesium-aluminum alloy melt." Id. at ¶ 0023. These intermediate alloys meet the Patent Owner's definition of "additive material," i.e., "a material that is added." Medlin Decl. Exhibit 2, at ¶ 110. The addition of these intermediate alloys to the melted magnesium alloy necessarily results in a mixture of the additive material and magnesium alloy. Id. at ¶ 111.
said additive material constituting at least 0.1 wt % of said mixture,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1. And Claim 2 discloses: a "magnesium alloy, according to

	Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum- nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, these claim elements are disclosed by Xiao
said magnesium in said magnesium composite constituting at least 85 wt %,	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao

	(emphasis added). Dr. Medlin opines that a POSITA would have understood that the range of non-magnesium elements in Claim 1 leaves 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Thus, Xiao discloses a range of magnesium up to 85 wt%, which overlaps with the claimed range (i.e. at least 85wt% magnesium means 85wt% or greater). Xiao also discloses a prior art magnesium alloy represented by Mg-Al-Zn (with AZ91D magnesium alloy being the most widely used) wherein the "main components of this alloy and the respective weight percentages are as follows: Al 8.3 to 9.7, Zn 0.35 to 1.0, Mn 0.15 to 0.5, and the remainder [(i.e. 88.8 to 91.2 wt%)] is magnesium." Id. at ¶ 0003; Medlin Decl. Exhibit 2 at ¶ 269. Xiao also uses an AZ91D as a comparative example alloy, with a composition of 9 wt% Al, 1 wt% Zn, 0.3 wt% Zr, and 0.1 wt% Mn, with the remainder (i.e. 89.6 wt%) being magnesium. Id. at ¶ 0032. Xiao teaches a primary difference between this prior art and its novel magnesium alloy lies in the addition of metallic elements like Iron, Copper, and/or Nickel into the alloy. Id. at ¶ 0026 ("[e]lements such as Fe, Cu, Ni, Ag, etc., in the magnesium alloy can form a large number of intermetallic composite micro-particles, which can improve the corrosion performance of the magnesium alloy, thereby promoting the decomposition of the magnesium alloy"). The dissolution data in Xiao (Xiao at ¶ 0061) teaches that the addition of Iron, Copper, and/or Nickel (alongside the Aluminum, Zinc, Zirconium, and Manganese of the prior art AZ91D example) caused a surprisingly large increase in dissolution rates. Thus, Xiao, as a whole, teaches magnesium compositions with magnesium content above 85wt% and "room" for the novel

	additive materials (i.e. "Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%" (Xiao at Claim 2)). Thus, Xiao fully discloses a range of magnesium of at least 85 wt %.
said additive material is a metal material selected from the group consisting of copper, nickel and cobalt,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
said magnesium composite including in situ precipitation of galvanically-active intermetallic phases that include said additive material,	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro- batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id.

	As Dr. Medlin explains, a POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 256. As noted above, at least Fe, Cu, and Ni are "additive materials." Consequently, the in-situ precipitation of galvanically- active intermetallic phases will include one or more of these additive materials.
said magnesium composite has a dissolution rate of 84-325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate within the claimed range of of at least three times the claimed "about 5-325 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor), Dr. Medlin opines that a POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "about 5" "about 5-325 mg/cm2/hr" at the claimed 90°C. Id. at ¶ 132. Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the

	weight percentages of the components is 100%." Xiao (emphasis added). Dr. Medlin opines that a POSITA would have understood that the range of non-magnesium elements in Claim 1 leaves 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Thus, Xiao discloses a range of magnesium up to 85 wt%, which overlaps with the claimed range (i.e. at least 85wt% magnesium) set forth in this claim element. Xiao also discloses a prior art magnesium alloy represented by Mg-Al-Zn (with AZ91D magnesium alloy being the most widely used) wherein the "main components of this alloy and the respective weight percentages are as follows: Al 8.3 to 9.7, Zn 0.35 to 1.0, Mn 0.15 to 0.5, and the remainder [(i.e. 88.8 to 91.2 wt%)] is magnesium." Id. at ¶ 0003; Medlin Decl. Exhibit 2 at ¶ 269. Xiao also uses an AZ91D as a comparative example alloy, with a composition of 9 wt% Al, 1 wt% Zn, 0.3 wt% Zr, and 0.1 wt% Mn, with the remainder (i.e. 89.6 wt%) being magnesium. Id. at ¶ 0032. Xiao teaches a primary difference between this prior art and its novel magnesium alloy lies in the addition of metallic elements like Iron, Copper, and/or Nickel into the alloy. Id. at ¶ 0026 ("[e]lements such as Fe, Cu, Ni, Ag, etc., in the magnesium alloy can form a large number of intermetallic composite micro-particles, which can improve the corrosion performance of the magnesium alloy, thereby promoting the decomposition of the magnesium alloy"). The dissolution data in Xiao (Xiao at ¶ 0061) teaches that the addition of Iron, Copper, and/or Nickel (alongside the Aluminum, Zinc, Zirconium, and Manganese of the prior art AZ91D example) caused a surprisingly large increase in dissolution rates.

	Thus, Xiao, as a whole, teaches magnesium compositions with magnesium content above 85wt% and "room" for the novel additive materials (i.e. "Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%" (Xiao at Claim 2)). Thus, Xiao fully discloses a range of magnesium of at least 85 wt %. As for the final limitation of Claim 74, it requires a dissolution rate of 84–325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C, as the discussion, supra, demonstrates, the novel examples explicitly analyzed in Xiao disclose dissolution rates only up to 74 mg/cm2/hr in 3 wt.% KCl water at 93°C, shy of this claimed range. Medlin Decl. Exhibit 2 at ¶ 330. However, Dr. Medlin opines that a POSITA in April 2014 would have understood Xiao to also teach dissolution rates above the floor of 84 mg/cm2/hr at 90°C claimed in Claim 74, because (1) the dissolution rates in the Xiao examples are very close to the claimed floor (e.g. Example 1 exhibited a rate of 74 mg/cm2/hr at 93°C, Example 6 a rate of 63 mg/cm2/hr at 90°C, and Example 7 a rate of 57 mg/cm2/hr at 93°C; and (2) a POSITA would have expected that other magnesium compositions having additive amounts in the ranges as disclosed by Xiao, but with higher amounts of copper, nickel, and/or iron than the amounts tested by Xiao's examples would have improved corrosion performance. Medlin Decl. Exhibit 2 at ¶ 331. In particular, even though they come close to the 84 mg/cm2/hr at 90°C, Examples 1, 6 and 7 of Xiao had less aggregate copper, nickel and iron than taught by Claim 2 of Xiao (i.e. 5 wt% for each of copper, nickel, and iron in a magnesium composite). Medlin Decl. Exhibit 2 at ¶ 331. Thus, the Examples in Xiao used lower amounts of these specific dissolution-enhancing

	additive elements. Thus, according to Dr. Medlin, a POSITA in April 2014 would have understood this and recognized that Xiao teaches magnesium compositions having dissolution rates above the claimed floor of "at least 84 mg/cm2/hr." Id. Dr. Medlin also notes that it was well-known prior to April 2014 that additions of copper, iron, nickel and cobalt cause a sharp linear increase in the corrosion rate of magnesium as evidenced by Shaw, "Corrosion Resistance of Magnesium Alloys" published in 2003 in the ASM Handbook, Vol. 13A (2003). Ex. 1204. Medlin Decl. Exhibit 2 at ¶ 332. As such, the recitation of the claimed dissolution rate of 84-325 mg/cm2/hr at 90°C was not a new property or use but rather a property that would be inherent in the compositions disclosed in Xiao, as confirmed by the extrinsic evidence of Shaw.
Dependent Claim 75	**Disclosure of Claim Element in Xiao and/or Prior Art Magnesium Disclosed in Xiao**
75. The magnesium composite as defined in claim 74, wherein said magnesium alloy is an AZ91D magnesium alloy that includes aluminum and zinc.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." ¶ 0026, ll. 1-3. Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Claim 1. A POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed range. Additionally, ¶ 0003 discloses a known aluminum alloy:

	The existing cast magnesium alloy is mainly represented by Mg-Al-Zn type magnesium alloys, and the AZ91D magnesium alloy is the most widely used. The main components of this alloy and the respective weight percentages are as follows: Al 8.3 to 9.7, Zn 0.35 to 1.0, Mn 0.15 to 0.5, and the remainder is magnesium. ¶ 0003.
Dependent Claim 76	**Disclosure of Claim Element in Xiao and/or Prior Art Magnesium Disclosed in Xiao**
76. The magnesium composite as defined in claim 74, wherein said additive material includes nickel,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.
a content of said nickel in said magnesium composite is at least 0.3 wt %.	Xiao teaches the use of a variety of metals as additive materials. See, e.g., ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel,

	and iron, among other metals. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.

iii. Ground III: Claims 7, 12–16, 18–21, 23–24, and 71 are Obvious over Xiao in combination with Hassan

i. Obviousness

A party that requests a determination of obviousness must show that "a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so." *Apotex Inc. v. Wyeth LLC*, IPR2014-00115, Paper 94, slip op. at 11 (Apr. 20, 2015) (quoting *Procter & Gamble Co. v. Teva Pharms. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009)). The obviousness determination turns on underlying factual inquiries involving: (1) the scope and content of prior art, (2) differences between claims and prior art, (3) the level of ordinary skill in pertinent art, and (4) secondary considerations such as commercial success and satisfaction of a long-felt need. *Procter & Gamble Co. v. Teva Pharm. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009) (quoting *Graham v. John Deere Co.*, 383 U.S. 1, 17, 86 S.Ct. 684, 15 L.Ed.2d 545 (1966)).

ii. Motivation to combine Xiao and Hassan

Dr Medlin opines that a POSITA in April 2014 would have been motivated to combine the disclosures of Xiao with the teachings of Hassan. Ex. 1002 at ¶ ¶ 337- 344. First, Xiao and Hassan are both directed to improving the properties of magnesium based materials, especially those for use in devices or tools. *Id.* Hassan, for instance, teaches that:

> increasing hostile service conditions that the modern engineering devices have to withstand have led the materials scientists across the globe to create new materials with enhanced properties when compared to the conventional materials. One way to improve the properties of conventional metallic

> materials is to reinforce them judiciously keeping the end application in mind. Among the reinforced metallic materials, magnesium based composites are becoming the strong candidates for lightweight structural application due to their superior specific mechanical properties.

Ex. 1007 at 2467. Hassan also recognizes that type of processing, type, size, and volume fraction of reinforcement are "common factors governing the end properties of a metal matrix composite[]." *Id.*

Xiao similarly teaches in the context of its smelt casted magnesium alloy, the use of reinforcing metals or metal alloys to enhance corrosion performance and/or improve the compressive strength of the formed magnesium material. Ex. 1006 at ¶ 0026. In particular, Xiao noted that existing magnesium alloys (such as AZ91D) had low compressive strength and slow decomposition rates, making them unsuitable as material for, for example, a tripping ball used in oil well drilling. *Id* at ¶ 0003. Xiao responded to those recognized problems in the art by "adjusting the chemical composition and preparation process" to prepare a light and pressure-proof cast magnesium alloy that adds elements which can enhance the corrosion performance of the magnesium alloy. *Id.* at ¶ 0004.

Dr. Medlin further opined that a POSITA would have been motivated to modify the disclosed magnesium alloys and magnesium-alloy-based tripping ball material taught in Xiao to further increase and/or control the rate of dissolution. Ex. 1002 at ¶ 340. More specifically, Dr. Medlin opined that a POSITA would look to Hassan, which teaches pure magnesium reinforced with nickel particulates that exhibits improved physical and mechanical properties over magnesium alloy AZ91. Id. at ¶ 341 (citing Ex. 1007 at p. 2467, col. 2). Hassan also teaches that careful "selection of reinforcing phase remains one of the most critical factors in developing a composite material with superior properties when compared to its monolithic counterparts." *Id.* Additionally, Medlin said that Hassan notes that its magnesium composites possess improved

thermal expansion and mechanical characteristics, which would be beneficial in oil field applications. *Id.* Accordingly, Dr. Medlin concludes that a POSITA in April 2014 would have recognized the benefits set forth in Hassan applied to the magnesium alloy used in the tools taught in Xiao. *Id.*

Hassan also teaches subjecting magnesium ingots to secondary processing. Dr. Medlin opines that a POSITA in April 2014 would have been motivated to treat the magnesium alloys disclosed in Xiao using the secondary processing techniques disclosed by Hassan such that the size of additive particulates and magnesium composite could be controlled and optimized. Ex. 1002 at ¶ 344.

Xiao already disclosed that controlling the particulate size of its magnesium alloy was desirable with argon treatment and a refining agent (rather than the deformation processing claimed in the '653 Patent). Ex. 1006 at ¶¶ 0036 and 0044. Dr. Medlin opined that a POSITA in April 2014 would have had a reasonable expectation of successfully combining the magnesium alloy of Xiao with the secondary processing techniques of Hassan, which were conventionally techniques known for decades to optimize particulate size of metal alloys and improve metal properties. Ex. 1002 at ¶ 343. Moreover, such processing techniques have been known for decades to optimize particulate size of metal alloys. See, e.g., Ex. 1203, 1:20-23 ("Powder metal technology is well known to the persons skilled in the art and generally comprises the formation of metal powders which are compacted and then subjected to an elevated temperature so as to produce a sintered product.").

iii. Independent Claim 12 and Dependent Claims 7, 13–16, 18–21, 23, 24, and 71 are Obvious over Xiao in combination with Hassan

A POSITA reading the disclosure of Xiao in combination with the disclosures of Hassan would have found obvious Claims 7, 12–16, 18–21, 23, 24, and 71 of the '653 Patent based on the following disclosures and motivation to combine Xiao and Hassan:

'653 Patent Claims/Elements	**Made Obvious by Disclosures of Xiao in Combination with Hassan**
Dependent Claim 7	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
7. The magnesium composite as defined in claim 1, where said magnesium composite is subjected to a deformation processing to reduce grain size of said magnesium composite, increase tensile yield strength of said magnesium composite, increase elongation of said magnesium composite, or combinations thereof.	As set forth in Ground I, supra, Xiao already discloses each and every element of the magnesium composition of Claim 1 from which Claim 7 depends. Xiao does not disclose subjecting that magnesium composite to deformation processing. Hassan explicitly discloses deformation processing. In particular, Hassan discloses that the deposited magnesium ingots may then be subjected to secondary processing. For example, Hassan teaches that the nickel-reinforced magnesium ingots are machined and hot extruded to obtain rods of 8 mm diameter. Id. Analysis of the composite of Hassan "showed the reduction in the size of elemental nickel particulates in the extruded composites" (see Table 1 (from Hassan (above)). In other words, the extrusion in Hassan resulted in a reduction of grain size of the magnesium composite. A POSITA in April 2014 would have been motivated to combine the disclosure of Xiao with this disclosure of deformation processing in Hassan rendering Claim 7 obvious. Accordingly, Claim 7 should be found obvious over Xiao in view of Hassan.

Independent Claim 12	Disclosure of Claim Element in Xiao and/or in Combination with Hassan
12. A magnesium composite that includes in situ precipitation of galvanically-active intermetallic phases to enable controlled dissolution of said magnesium composite comprising a mixture of a magnesium or a magnesium alloy and an additive material,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." ¶ 0026, ll. 1-3. Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." ¶ 0026. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Thus, this claim element was disclosed by Xiao. Xiao discloses "first loading pure magnesium and pure aluminum into a smelting furnace . . . next loading pure zinc and an [sic] intermediate alloys of trace element components into a

	resulting magnesium-aluminum alloy melt after melting." ¶ 0022. Xiao discloses that "Al-Fe ... Al-Ni ... Al-Cu ... Al- Ag ... Al-Zr ... and ... Al-Ti intermediate alloy[s], are heated to dry and then added to the magnesium-aluminum alloy melt." Id. at ¶ 0023. The addition of these intermediate alloys to the melted magnesium alloy necessarily results in a mixture of the additive material and magnesium alloy.
said additive material having a greater melting point temperature than a solidus temperature of said magnesium,	Using a typical phase diagram, a POSITA in April 2014 would have readily determined that the solidus temperature of magnesium is the temperature at which a metal first begins to melt during heating and not necessarily when the metal is completely liquidus. RESPECTIVE DIAGRAM OMITTED Ex. 1213. A POSITA would also use this phase diagram to find the solidus temperature of the magnesium-aluminum alloy disclosed in Xiao to be in a range of 650°C for pure magnesium and down to 437°C for aluminum additions in the range of 13 wt% to 25% and even up to 40 wt%. The POSITA using typical phase diagrams for each of the additive materials (here the Al-Fe, Al-Ni, Al-Cu, Al-Ag, Al-Zr, Al-Ti "intermediate alloys" disclosed in Xiao) would be able to readily determine the melting point temperature for each intermediate alloy. (¶ 0023). For example, the Al-Fe phase diagram (Ex. 1205) shows a variable melting point temperature ranging from 1538°C (pure iron) down to 655°C for a eutectic temperature between about 63 wt% aluminum to near 99 wt% aluminum. The Al-Ni phase diagram (Ex. 1206) shows a variable melting point temperature that ranges from 1640°C down to 640°C depending upon the alloy content. The Al-Cu (Ex. 1207) phase diagram shows a variable melting point temperature ranging from 548°C up to 1084°C depending upon

	the alloy mixture. A POSITA in April 2014 would have readily determined the specific melting temperature of a specific alloy mixture based on these phase diagrams. Xiao discloses a variety of Al-Fe, Al-Ni, Al-Cu, Al-Ag, Al-Zr, Al-Ti alloy mixtures with a variety of constituencies. For instance, Xiao specifically teaches in Example 7 that: The composition of the alloy and the respective percentages by weight are as follows: 25% Al-10% Zn-1% Fe-0.5% Ni-0.1% Cu- 0.5% Ti-0.05% Zr, and the remainder is Mg. ¶ 0058-59. Xiao teaches that the magnesium alloy of Example 7, as a whole, ends up with the maximum amount of aluminum (i.e. 25 wt%) taught as being within the invention of Xiao (see, ¶ 0026). Xiao specifically discloses—with respect to Example 7—that portions of that aluminum content are added into a magnesium-aluminum melt as an Al-Fe intermediate alloy, an Al-Ni intermediate alloy, an Al-Cu intermediate alloy, an Al-Ag intermediate alloy, an Al-Zr intermediate alloy, and an Al-Ti intermediate alloy. ¶ 0060. By converting weight percentages to grams and calculating mass balances, a POSITA would first determine the relative concentrations of the pure magnesium and pure aluminum initially loaded into the smelting furnace in order to determine its solidus temperature. As a result, a POSITA would have understood in April 2014 that Example 7 of Xiao includes 62.85 total grams of magnesium. The following intermediate alloy compositions were chosen for the initial mass balance calculations: Al-Fe (30 wt% Fe), Al-Ni (45 wt% Ni), Al-Cu (40 wt% Cu), Al-Ti (10 wt% Ti), Al-Zr (20 wt% Zr) alloy mixtures. A POSITA in April 2014 would have performed the initial mass balances, included herewith as the Mass/Balance Exhibit 2, on these compositions. Using these initially selected alloy compositions would have resulted in 7.79

	grams of Aluminum being added as components of the intermediate alloys. Since Example 7 of Xiao calls for a total of 25 grams (i.e. 25 wt%) of Aluminum, 17.21 grams of Aluminum would have had to have been initially loaded into the smelting furnace in Example 7 along with the 62.85 grams of magnesium (see calculation above). Thus, the initial melt of Example 7 (using the intermediate alloys selected) would have had a composition of 78.5 wt% Mg and 21.5 wt% Al. A POSITA in April 2014 would have next consulted the Mg-Al phase diagram to determine that the solidus temperature of that initial magnesium alloy (i.e. 78.5 wt% Mg and 21.5 wt% Al) would be 437 °C. A POSITA would also consult the relevant phase diagram to determine the melting point temperature of the various additive materials disclosed in Xiao. Id. at ¶ 122. An aluminum-iron alloy with 30 wt% iron would have a melting point temperature of 655 °C, an aluminum-nickel alloy with 45 wt% Ni would have a melting point temperature of 854 °C, an aluminum-copper alloy with 40 wt% Cu would have a melting point temperature of 548°C, an aluminum-titanium alloy with 10 wt% Ti would have a melting point temperature of 665°C, and an aluminum-zirconium alloy with 20 wt% Zr would have a melting point temperature of 661°C. Thus, each of these additive materials from Example 7 of Xiao (with the constituencies selected above) would have had a greater melting point temperature than the solidus temperature (i.e. 437°C) of the magnesium-aluminum alloy (78.5 wt% Mg and 21.5 wt% Al) calculated as the amount of pure aluminum and magnesium initially loaded into the smelting furnace in Example 7. A POSITA in April 2014 would have recognized that other compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-

	Ni, and Al-Cu intermediate alloys having greater melting point temperatures than the solidus temperature of initial magnesium alloy loaded in the various disclosures of Xiao. Thus, Xiao discloses all of the limitations of this claim element.
said composite including greater than 50 wt % magnesium,	Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Claim 1. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed ranges set forth in these claim elements.
said additive material constituting about 0.05-45 wt % of said magnesium composite,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which a POSITA could calculate the specific weight percentage (ranges) of each additive material or secondary metal. In doing so, a POSITA would determine that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. For example, the aluminum-iron additive constitutes

	3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. A POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Accordingly, this claim element was disclosed by Xiao.
said additive material having a melting point temperature that is 100°C. greater than a melting temperature of said magnesium or magnesium alloy,	A POSITA in April 2014 would have understood "melting temperature" in this claim element to be a reference to the smelting temperature or temperature of the melt when the additive material is being added to the magnesium or magnesium alloy, not the "melting point temperature" as that measurement is used for the additive material. Xiao generally discloses "loading pure magnesium and pure aluminum into a smelting furnace and increasing the temperature to 700 to 730 °C, next loading pure zinc and an [sic] intermediate alloys . . . into a resulting magnesium-aluminum alloy melt after melting and increasing the temperature to 740 to 780°C . . . ." ¶¶ 0021–0022; see also Id. at Claim 5 ("the melting temperature of the pure magnesium and pure aluminum is from 700 to 730 °C.") Examples 1–7 of Xiao teach a range of smelting temperatures for the magnesium-aluminum alloy from 700°C (Example 1) to 730°C (Examples 2, 5, and 7). ¶¶ 0034–0060. The additive materials noted above are one or more of the intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ag, Al-Zr, Al-Ti. Id. at ¶ 0023. A POSITA using typical phase diagrams for each of these additive materials would be able to readily determine the melting point temperature.

	Example 7 of Xiao specifically discloses a melting or smelting temperature of 730°C. ¶ 0060. A POSITA in April 2014 would have recognized from Example 7 of Xiao that at least an aluminum-nickel additive having 45 wt% nickel has a melting point temperature of 854°C which is 100°C greater than the melting or smelting temperatures of the magnesium aluminum alloy used in Example 7 (i.e., 730°C) and otherwise taught generally by Xiao (i.e., 700-730°C). A POSITA in April 2014 would have also recognized that other intermediate alloy compositions could have fallen within the teachings of Example 7 and other disclosures of Xiao and resulted in Al-Fe, Al-Ni, and Al-Cu intermediate alloys that would have had melting point temperatures that were 100°C. greater than the smelting temperatures of the magnesium alloy generally taught by Xiao (i.e., 700- 730°C). Thus, this claim element was disclosed by Xiao.
said additive material including one or more metals selected from the group consisting of copper, nickel, cobalt, titanium, and iron,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including, in particular, copper, nickel, and iron, among other metals. Thus, Xiao discloses a number of metal additives, including copper, nickel, and iron and, hence fully discloses all of the limitations of these claim elements.

at least a portion of said additive material remaining unalloyed additive material,	Xiao discloses that "[e]lements such as Fe, Cu, Ni, Ag, etc., in the micro-particles." ¶ 0026. However, Xiao does not disclose whether any of the additive material remains "unalloyed". Hassan explicitly discloses that magnesium composites containing additive materials, such as nickel may remain unreacted. In particular, Hassan discloses that the [s]evere reaction between magnesium melt and nickel particulates during DMD processing led to the reduction of the particulate size and formation of Mg2Ni intermetallics [13]. The results of quantitative determination of unreacted nickel (see Table I), microstructural characterization illustrating the presence of reaction products (see Fig. 1) and XRD results (see Table II) showing the presence of Mg2Ni supports the experimental observations." Thus, Hassan specifically provides experimental data showing— under similar conditions of magnesium composite fabrication as those in Xiao—that some of the additives, particularly nickel, will remain unreacted and unalloyed. Given the motivation to combine Xiao with Hassan, a POSITA in April 2014 would have combined these two references thereby providing further rationale that a POSITA in April 2014 would find Claim 12 of the '653 Patent obvious.
said magnesium composite including in situ precipitation of galvanically-active intermetallic phases that includes said unalloyed additive material,	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase

	which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a reference to intermetallic precipitate. As noted above, at least Fe, Cu, and Ni are "additive materials." Consequently, the in-situ precipitation of galvanically-active intermetallic phases will include one or more of these additive materials. Thus, Xiao discloses all of this claim limitation. Xiao discloses that "[e]lements such as Fe, Cu, Ni, Ag, etc., in the micro- particles." Id. at ¶ 0026. However, Xiao does not disclose whether any of the additive material remains "unalloyed". Hassan explicitly discloses that magnesium composites containing additive materials, such as nickel may remain unreacted. In particular, Hassan discloses that the [s]evere reaction between magnesium melt and nickel particulates during DMD processing led to the reduction of the particulate size and formation of Mg2Ni intermetallics [13]. The results of quantitative determination of unreacted nickel (see Table I), microstructural characterization illustrating the presence of reaction products (see Fig. 1) and XRD results (see Table II) showing the presence of Mg2Ni supports the experimental observations." Ex. 1007 at 2472. Thus, Hassan specifically provides experimental data showing— under similar conditions of magnesium composite fabrication as those in Xiao—that some

	of the additives, particularly nickel, will remain unreacted and unalloyed. Given the motivation to combine Xiao with Hassan (discussed, supra), Dr. Medlin opined that a POSITA in April 2014 would have combined these two references thereby providing further rationale that a POSITA in April 2014 would find Claims 12 and 71 of the '653 Patent obvious.
said magnesium composite has a dissolution rate of at least 5 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. The disclosed table provides seven examples (excluding the comparative [prior art] example). ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Thus, each of Xiao's seven examples (excluding the comparative [prior art] example) has a dissolution rate of at least three times the claimed "at least 5 mg/cm2/hr in 3 wt.% KCl water" at both 70°C or 93°C (with Example 7 being more than seven times that floor). A POSITA in April 2014 would have recognized that the dissolution rate of the examples in Xiao would necessarily have been well above the claimed floor of "at least of 5 mg/cm2/hr" at the claimed 90°C.
Dependent Claim 13	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
13. The magnesium composite as defined in claim 12, wherein said additive	With respect to the additional limitations added by this dependent claim, Xiao discloses "first loading pure magnesium and pure aluminum into a smelting furnace, next loading pure

material is added to said magnesium or magnesium alloy while said magnesium or magnesium alloy is at a temperature that is above said solidus temperature of said magnesium and a temperature that is less than a melting point of said additive material to form said mixture.	zinc and an [sic] intermediate alloys . . . into a resulting magnesium-aluminum alloy melt after melting." Xiao at Claim 4. Hassan, discloses, in particular, magnesium as a base material "and elemental nickel particulates of 99.9% purity (Johnson Matthey, MA, USA) with an average size of 29±19 μm were used as reinforcement phase" and that "[t]he synthesis of the composites involved superheating the magnesium turnings with reinforcement particulates (placed in multi-layer sandwich form) to 750°C under inert Ar gas atmosphere in a graphite crucible." Ex. 1007 at p. 2468. A POSITA would have known in April 2014 that the melting point of pure magnesium is 650°C and the melting point of pure nickel is 1455°C using standard phase diagrams for Mg and Ni, respectively. Medlin Decl. Exhibit 2 at ¶ 51. Given these values and the disclosure in Hassan of heating only to 750°C, the combination of Xiao and Hassan necessarily teach the limitations of Claim 13.
Dependent Claim 14	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
14. The magnesium composite as defined in claim 13, wherein said magnesium alloy includes over 50 wt % magnesium and one or more metals selected from the group consisting of aluminum in an amount of about 0.5-10 wt %, zinc in amount of about 0.1-3 wt %, zirconium in an amount of	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-

about 0.01-1 wt %, manganese in an amount of about 0.15-2 wt %, boron in amount of about 0.0002-0.04 wt %, and bismuth in an amount of about 0.4-0.7 wt %.	85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed range. This claim element would be anticipated solely by the zirconium concentrations falling within the 0.01-1 and/or 0.01-3 wt% ranges. Claim 14 also requires, in addition to a similar zirconium concentration to the Markush claims, a zinc concentration of 0.1-3 wt%.
Dependent Claim 15	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
15. The magnesium composite as defined in claim 14, wherein said additive material includes nickel,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including nickel, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including nickel, and hence fully discloses all of the limitations of these claim elements.

said nickel constitutes about 0.05-35 wt % of said magnesium composite,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1. And Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of

	the mixture. Id. at ¶ 125. Accordingly, this claim element was disclosed by Xiao.
said nickel forms galvanically-active in situ precipitate in said magnesium composite.	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 16	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
16. The magnesium composite as defined in claim 15, wherein said additive material includes nickel,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April

	2014 would have understood that all of these intermediate alloys contain metal, including nickel, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including nickel, and hence fully discloses all of the limitations of these claim elements.
said nickel constitutes about 3-7 wt % of said magnesium composite.	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1. And Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin

	expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, this claim element was disclosed by Xiao.
Dependent Claim 18	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
18. The magnesium composite as defined in claim 15, wherein a dissolution rate of said magnesium composite is at least 45 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C. and up to 325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Six of the seven examples (excluding the comparative [prior art] example) provided in Xiao therefore discloses a dissolution rate of "at least 45 mg/cm2/hr in 3 wt % KCl water" and "up to 325 mg/cm2/hr in 3 wt % KCl water" at 93°C. Given that the dissolution rates of Xiao slightly above (i.e., 3°C above) 90°C are almost all above the claimed floor of "at least 45 mg/cm2/hr". As such and per Dr. Medlin's opinion, a POSITA in April 2014 would have expected the dissolution rate of the examples in Xiao at 90°C to also be necessarily above the

	claimed floor of "at least 45 mg/cm2/hr." Medlin Decl. Exhibit 2 at ¶ 205. Thus, this element is disclosed by Xiao.
Dependent Claim 19	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
19. The magnesium composite as defined in claim 12, wherein said magnesium alloy includes over 50 wt % magnesium and one or more metals selected from the group consisting of aluminum in an amount of about 0.5-10 wt %, zinc in amount of about 0.1-6 wt %, zirconium in an amount of about 0.01-3 wt %, manganese in an amount of about 0.15-2 wt %, boron in amount of about 0.0002-0.04 wt %, and bismuth in an amount of about 0.4-0.7 wt %.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. Claim 1 of Xiao discloses a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%; the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1 (emphasis added). Dr. Medlin opines that a POSITA would have understood that the total range of the non-magnesium elements disclosed in Claim 1 of Xiao is 15 to 40%, leaving 60-85 wt% for magnesium. Medlin Decl. Exhibit 2 at ¶ 149. Dr. Medlin also notes that the "Examples of Xiao disclose a range of magnesium from 54.5 wt% - 79.2 wt%." Id. Thus, Xiao discloses a range of magnesium 54.5-85 wt%, which overlaps and covers much of the claimed range. This claim element would be anticipated solely by the zirconium concentrations falling within the 0.01-1 and/or 0.01-3 wt% ranges. Claim 14 also requires, in addition to a similar zirconium concentration to the Markush claims, a zinc concentration of 0.1-3 wt%.
Dependent Claim 20	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
20. The magnesium composite as defined in claim	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9.

12, said additive material includes nickel,	Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including nickel, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number of metal additives, including nickel, and hence fully discloses all of the limitations of these claim elements.
said nickel constitutes about 0.05-35 wt % of said magnesium composite,	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1. And Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal.

	In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions would have fallen within the teachings of Example 7 and other disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, this claim element was disclosed by Xiao.
said nickel forms galvanically-active in situ precipitate in said magnesium composite.	Xiao discloses a novel magnesium alloy with high aluminum and zinc content further adding elements Fe, Cu, Ni and Ag which can form intermetallics and enhance the corrosion performance of the magnesium alloy. Xiao at ¶ 0026. Xiao explains the corrosion mechanism within a magnesium alloy in terms of a cathode phase, which Xiao explains includes "the β (Mg17Al12) phase and eutectic phase on the grain boundary of the magnesium alloy," and "the magnesium matrix α phase which functions as an anode phase, so that the matrix and the grain boundary of the magnesium alloy form a large amount of micro-batteries, which [micro-batteries] greatly accelerate the corrosion decomposition of magnesium alloy." Id. A POSITA in August 2014 would have understood this disclosure of "intermetallic composite micro-particles" to be a

	reference to intermetallic precipitate. Medlin Decl. Exhibit 2 at ¶ 107. A POSITA reading the Xiao reference in April 2014 would have recognized that the precipitation of galvanically-active intermetallic phases ("micro-batteries") are naturally and necessarily generated by the in situ reaction between magnesium and any and all of the disclosed metal additives forming in situ precipitate. Medlin Decl. Exhibit 2, at ¶ 108. Thus, these claim elements were disclosed by Xiao. These elements are among the claimed "secondary metals" disclosed by Xiao. Thus, all of the limitations of this claim element are disclosed by Xiao.
Dependent Claim 21	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
21. The magnesium composite as defined in claim 20, wherein said additive material includes nickel,	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the novel magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ."Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these intermediate alloys contain metal, including nickel, among other metals. Medlin Decl. Exhibit 2 at ¶ 145. Thus, Xiao discloses a number

	of metal additives, including nickel, and hence fully discloses all of the limitations of these claim elements.
said nickel constitutes about 3-7 wt % of said magnesium composite.	Claim 1 of Xiao discloses: a "magnesium alloy, comprising the components at the weight percentages as follows: Al: 13 to 25%, Zn: 2 to 15%, the remainder is Mg, and a sum of the weight percentages of the components is 100%." Xiao at Claim 1. And Claim 2 discloses: a "magnesium alloy, according to Claim 1, further comprising the trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%; and a sum of the weight percentages of the components is 100%." Id. at Claim 2. These metallic elements are found in the additive materials generally disclosed by Xiao (i.e., intermediate alloys: Al-Fe, Al-Ni, Al-Cu, Al-Ti) (Xiao at ¶ 0023) and particularly described in association with Example 7 of Xiao (Id. at ¶¶ 0057–0060) for which Dr. Medlin calculated for Example 7 of Xiao (Medlin Decl. Exhibit 2 at ¶¶ 113–122) the specific weight percentage (ranges) of each additive material or secondary metal. In particular, Dr. Medlin determined that the additive materials aluminum-iron with 30 wt% iron, aluminum-nickel with 45 wt% nickel, and aluminum-copper with 40 wt% copper also fall well within the range of about 0.05 wt% to 45 wt% of the mixture. Id. ¶ 122. For example, the aluminum-iron additive constitutes 3.3 wt% of the mixture; the aluminum-nickel additive constitutes 1.1 wt% of the mixture; and the aluminum-copper additive constitutes 0.25 wt% of the mixture. Dr. Medlin expressed his opinion that a POSITA in April 2014 would have also recognized that other intermediate alloy compositions ould have fallen within the teachings of Example 7 and other

	disclosures of Xiao resulting in Al-Fe, Al-Ni, and Al-Cu intermediate alloys constituting about 0.05 wt% to 45 wt% of the mixture. Id. at ¶ 125. Accordingly, this claim element was disclosed by Xiao.
Dependent Claim 23	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
23. The magnesium composite as defined in claim 12, wherein a dissolution rate of said magnesium composite is at least 45 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C. and up to 325 mg/cm2/hr. in 3 wt % KCl water mixture at 90°C.	A POSITA in April 2014 would have recognized that Xiao disclosed a table of dissolution rates ("decomposition rates") because the units of measurement are the units used by POSITAs to measure dissolution rates. Medlin Decl. Exhibit 2 at ¶ 129. The disclosed table provides seven examples (excluding the comparative [prior art] example). Xiao at ¶ 0064. Xiao provides dissolution rates in g/cm2/hr, while the claims of the '653 Patent express dissolution rates in mg/cm2/hr. A POSITA would have known converting between g/cm2/hr to mg/cm2/hr, merely requires multiplication by 1,000. Medlin Decl. Exhibit 2 at ¶ 130. Six of the seven examples (excluding the comparative [prior art] example) provided in Xiao therefore discloses a dissolution rate of "at least 45 mg/cm2/hr in 3 wt % KCl water" and "up to 325 mg/cm2/hr in 3 wt % KCl water" at 93°C. Given that the dissolution rates of Xiao slightly above (i.e., 3°C above) 90°C are almost all above the claimed floor of "at least 45 mg/cm2/hr". As such and per Dr. Medlin's opinion, a POSITA in April 2014 would have expected the dissolution rate of the examples in Xiao at 90°C to also be necessarily above the claimed floor of "at least 45 mg/cm2/hr." Medlin Decl. Exhibit 2 at ¶ 205. Thus, this element is disclosed by Xiao.
Dependent Claim 24	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**

24. The magnesium composite as defined in claim 12, wherein said additive material is a metal or metal alloy.	Xiao discloses a "magnesium alloy...and further adds elements of Fe, Cu, Ni, and Ag which can enhance the corrosion performance of the magnesium alloy..." Xiao at ¶ 0026, ll. 1–9. Xiao teaches the use of a variety of metals as additive materials. See, e.g., Xiao at ¶ 0026. For instance, Xiao claims that the magnesium alloy may "further compris[e] trace elements at the weight percentages as follows: Fe: 0.1 to 5%, Cu: 0.05 to 5%, Ni: 0.05 to 5%, Zr: 0.05 to 0.5%, Ti: 0.05 to 0.5%. . ." Id. at Claim 2. In addition, Example 7 of Xiao particularly discloses intermediate alloys Al-Fe, Al-Ni, Al-Ag, Al-Cu, Al-Zr, Al-Ti and Zinc as additive materials. Id. at ¶ 0060. A POSITA in April 2014 would have understood that all of these additive materials contain metal(s). Medlin Decl. Exhibit 2 at ¶ 145. Accordingly, Example 7 of Xiao discloses this claim element in accordance with Patent Owner's definition of "additive material."
Dependent Claim 71	**Disclosure of Claim Element in Xiao and/or in Combination with Hassan**
71. The magnesium composite as defined in claim 49, wherein at least a portion of said additive material remains unalloyed additive material in said magnesium composite.	Xiao discloses that "[e]lements such as Fe, Cu, Ni, Ag, etc., in the micro-particles." Id. at ¶ 0026. However, Xiao does not disclose whether any of the additive material remains "unalloyed". Hassan explicitly discloses that magnesium composites containing additive materials, such as nickel may remain unreacted. In particular, Hassan discloses that the [s]evere reaction between magnesium melt and nickel particulates during DMD processing led to the reduction of the particulate size and formation of Mg2Ni intermetallics [13]. The results of quantitative determination of unreacted nickel (see Table I), microstructural characterization illustrating the presence of

	reaction products (see Fig. 1) and XRD results (see Table II) showing the presence of Mg2Ni supports the experimental observations." Ex. 1007 at 2472. Thus, Hassan specifically provides experimental data showing— under similar conditions of magnesium composite fabrication as those in Xiao—that some of the additives, particularly nickel, will remain unreacted and unalloyed. Given the motivation to combine Xiao with Hassan (discussed, supra), Dr. Medlin opined that a POSITA in April 2014 would have combined these two references thereby providing further rationale that a POSITA in April 2014 would find Claim 12 of the '653 Patent obvious.

X. CONCLUSION

Requester respectfully requests the *ex parte* reexamination of claims 1–5, 7–9, 11–16, 18–21, 23–50, 52–62, 64, 66, 67, and 69–78.

Respectfully submitted,

Date: July 6, 2021

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