

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

FIRST NAMED INVENTOR : Brian P. Doud

TITLE : GALVANICALLY-ACTIVE IN SITU
FORMED PARTICLES FOR
CONTROLLED RATE DISSOLVING
TOOLS

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EXAMINER : Sean E. Vincent

ATTORNEY DOCKET NO. : 36136-0034

DECLARATION OF LEE A. SWANGER, PH.D., P.E. UNDER 37 C.F.R. § 1.132

1. My name is Lee A. Swanger. This Declaration is submitted on behalf of the assignee, Terves, LLC, of U.S. Patent No. 10,329,653 being reexamined under Application Serial No. 90/014,795 ("the '795 Reexam"). I understand that petitioner Ecometal, Inc. is challenging the validity of Claims 1-5, 7-9, 11-16, 18-21, 23-50, 52-62, 64, 66, 67, and 69-76 of the '795 Reexam in a request for ex parte re-examination before the United States Patent and Trademark Office ("the USPTO").

2. I have been provided with the July 6, 2021 *Declaration of Dana J. Medlin* in this re-examination matter, with the *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 (dated July 6, 2021), and with the USPTO *Reexamination Non-Final Rejection* – (Mail Date 11/19/2021). I have also considered two references cited by Dr. Medlin:

- a. *Chinese Patent Publication No. CN 103343271* by Xiao (“Xiao”)
- b. *Development of high strength magnesium bases composites using elemental nickel particulates as reinforcement* by S.F. Hassan and M. Gupta (“Hassan”)

3. In this Declaration, I will be offering my opinions on the statements in the USPTO *Reexamination Non-Final Rejection* and will only refer to Dr. Medlin’s Declaration as necessary.

Qualifications

4. I am employed by Exponent, Inc. as a Principal Engineer in Exponent’s Miami, Florida office. My background is in the area of both metallurgical engineering, including physical metallurgy, and mechanical engineering. I have a B.S. in Metallurgy, with Highest Honors, from the Case Western Reserve University, an M.S. in Materials Science and Engineering from Stanford University, and a Ph.D. in Materials Science and Engineering, also from Stanford University. I joined The Ohio State University Department of Materials Science and Engineering as a Post-Doctoral Research Associate studying corrosion, in conjunction with Professor Mars Fontana and Professor Roger Staehle. I served as an Adjunct Professor of Engineering, teaching metallurgical engineering, at the University of Miami, and at Cleveland State University. I am a Registered Professional Engineer in several states in both metallurgical engineering and in mechanical engineering, and have been a member of ASM International (formerly the American Society for Metals) since 1968. As set forth in more detail in my curriculum vitae (Exhibit A), I have substantial experience in the areas of metallurgical engineering and alloy design. Prior to joining

Exponent, I was Director of Research and Development for the Engine Parts Division of Gould, Inc. While at Gould I was the sole inventor of U.S. Patent 4,333,215 in the metallurgical art, and assisted my attorney in the prosecution of that patent.

Claim Construction

5. For this Declaration and for the opinions herein, I am using the Court's Order (ECF 89 – Exhibit B) regarding the claim construction terms and the ordinary metallurgical, electrochemical, and thermodynamic meaning of all other terms as would be understood by a person of ordinary skill in the art ("POSITA") that I have defined in paragraph 12 of this Declaration.

Legal Standard for Invalidity:

6. Anticipation: I have been told that under 35 U.S.C. § 102, to show that a patent claim is invalid as anticipated, there must be, by a preponderance of the evidence, a single prior art reference that discloses each and every element of a claimed invention.

7. Obviousness: I have been told that under 35 U.S.C. § 103(a), and proven by a preponderance of the evidence, "[a] patent may not be obtained although the invention is not identically disclosed or described as set forth in Section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter would have been obvious at the time the invention was made to a person having ordinary skill in the art [a POSITA] to which said subject matter pertains."

8. When considering the issues of obviousness, I have been told that I am to analyze the following four factors:

- a. Determine the scope and content of the prior art;
- b. Ascertain the differences between the prior art and the claims at issue;
- c. Resolve the level of ordinary skill in the pertinent art; and
- d. Consider evidence of objective indicia of non-obviousness.

9. Timeframe: I have been told that the relevant time for considering whether a claim would have been obvious to a POSITA at the time of alleged invention, which is before the priority filing date of the '795 Reexam, April 18, 2014.

10. I have been told that the teachings of two or more references may be combined as part of determining the differences between the prior art and the claims. However, a POSITA must be motivated to combine those references. If there is no evidence of motivation to combine the teachings of two or more references, then a POSITA would not have combined them.

11. I have been told that analyzing these four factors to determine either obviousness or non-obviousness must be done from a view of that hypothetical POSITA at or before the time of the invention. In addition, I have been informed and I understand that there must be a reasonable expectation of success -- not absolute predictability of success -- in combining prior art teachings to arrive at the claimed invention. Without that reasonable expectation of success, there can be no obviousness finding.

12. A POSITA at the time of the invention (April 18, 2014) would have at least a Bachelor's Degree in chemistry, material science and engineering, metallurgy, or a related scientific degree, and at least five years of experience in working with dissolvable metallic-based materials.

13. The specific experience with dissolvable metallic-based materials is significant because the majority of engineers and scientists working in chemistry, metallurgy, or corrosion are

focused on two different aspects of electrochemistry -- either a) preventing or minimizing corrosion, or b) electroplating of metals and wherein the dissolution of the anode is assumed since the effort is all directed toward effective and efficient deposition of electroplated material on the cathode.

14. The '795 Reexam is directed to those already skilled in the art of producing dissolvable metallic magnesium-based materials. Based on my own education, training, and experience in metallurgy, materials science and engineering, chemistry, corrosion, and electroplating (including studying anodic dissolution for efficient electroplating of bearings and production of copper foil for printed circuit board by electrodeposition), I am familiar with the training and experience required to be a POSITA in this particular art, and I was a POSITA well prior to 2014.

15. As a safeguard against slipping into use of hindsight, and to resist the temptation to read into the prior art the teachings of the invention at issue, evidence of objective indicia of non-obviousness must be analyzed prior to making the ultimate determination of whether or not an invention is obvious.

16. Objective indicia of non-obviousness often are the most probative and cogent evidence of non-obviousness.

17. Failure to give proper consideration to such evidence can be fatal, because a hindsight view of obviousness may not be so apparent in view of objective evidence of non-obviousness.

18. Evidence showing objective indicia of non-obviousness can include copying, long-felt but unresolved need, praise by others, commercial success, and unexpected results. I have

been told that any assertion of objective indicia must be accompanied by a nexus between the patent claims and the evidence offered.

19. Copying: Copying may indeed be another form of flattering praise for inventive features. Copying requires evidence of efforts to replicate a specific product. This may be demonstrated either through a) internal documents or b) disassembling a patented product and building a virtually identical replica of that patented product; or access to, and substantial similarity to, the patented product.

20. Long-Felt But Unresolved Need: Long-felt need is particularly probative of non-obviousness when it demonstrates both that a demand existed for the patented invention, and that others tried but failed to satisfy that demand.

21. Praise by Others: Praise from industry participants, especially competitors, is probative as to non-obviousness.

22. Commercial Success: The commercial success of a product protected by the patented invention is strong evidence of non-obviousness. To show commercial success, a nexus must exist between the patented features and why customers purchased the patented product.

23. Unexpected Results: That the claimed invention yields unexpectedly improved properties or properties not present in the prior art is also evidence of non-obviousness.

Summary of Opinions

24. Xiao does not anticipate the Challenged Claims of the '795 Reexam because Xiao does not disclose each and every element of any of the asserted claims. None of the Challenged Claims are obvious under either Xiao, or under Xiao in light of Hassan. Xiao discloses magnesium alloys with a composition of aluminum between 13 wt. % and 25 wt. % which form micro-batteries

with $Mg_{17}Al_{12}$ cathodes, based on the Mg – Al phase diagram. Xiao does not teach or disclose galvanically-active intermetallic particles created with secondary metals such as nickel or copper. Hassan discloses a nickel particle reinforced magnesium metal-metal composite that will withstand hostile conditions (i.e., it will resist corrosion).

Background of the Xiao Patent

25. The Xiao invention is for a “light and pressure-proof fast-decomposed cast magnesium alloy” which “can be used as a tripping ball material for a multi-stage sliding sleeve staged fracturing technique.” The magnesium alloy disclosed and claimed in Claim 1 of Xiao is very rich in the alloy elements aluminum (13 to 25 weight percent) and zinc (2 to 15 weight percent). Dependent Claim 2 of Xiao adds additional trace elements comprising iron (Fe), copper (Cu), nickel (Ni), zirconium (Zr) and titanium (Ti) for a total of eight elements. I understand that the term “comprising” means the invention includes, but is not limited to, the elements identified in the claim. I also understand that the conjunction and (emphasized above) requires all of the listed trace elements, not a subset thereof. Therefore, Xiao discloses and claims the complete collection of trace elements, and not a menu for selection of one or more of the trace elements.

26. I have reviewed the Chinese language version of Xiao and an English translation of Xiao. Table 1 at [0062] of Xiao has as its first entry in column 1 the widely used commercial magnesium alloy AZ91D, and that row lists the well-known alloying elements in this alloy. The final column, labeled “Mg” clearly refers to magnesium as the balance, or the remainder, of the alloy. The next seven rows, by comparison, would identify other magnesium alloys by alloying additions and their elemental composition and indicating that the balance of the alloy is magnesium.

27. Xiao at [0064] shows Table 2 with seven rows, corresponding to the seven rows of Table 1 [0062] with the same first-column entries, and with three columns of data. The first column uses the Greek letter σ (sigma) which is the universal symbol for stress. In the second column, the units (MPa) are megapascals, used to denote tensile strength or yield strength, and the values for the Xiao examples 1 through 7, ranging from 360 MPa to 410 MPa, equivalent to 52,000 psi to 60,000 psi, are typical for light-weight non-ferrous metal alloys such as magnesium and aluminum alloys, and clearly superior to the strength listed for AZ91D of 232 MPa or 34,000 psi. The next two columns, with units of $\text{gm.cm}^{-2}.\text{h}^{-1}$ (grams per square centimeter per hour), indicate changes in mass per unit area per unit time. Multiplying the values by 1,000 converts them to milligrams per square centimeter per hour, the same units used in the claims of the '795 Reexam. These values are either a rate of weight gain or a rate of weight loss, and for a "fast-decomposed cast magnesium alloy" the values would be weight *loss* rates, as claimed in the '795 Reexam.

28. Indeed, Xiao states that a decomposition rate or weight loss rate of at least 0.02 $\text{gm/cm}^2/\text{hr.}$ (20 $\text{mg/cm}^2/\text{hr.}$) is required to satisfy the stated needs. Thus, a POSITA would understand that the magnesium alloy in Xiao's Claim 1, consisting of only magnesium, aluminum, and zinc, would dissolve at a rate of at least 20 $\text{mg/cm}^2/\text{hr.}$

29. Xiao distinguishes his invention over the well-known magnesium alloy AZ91D, which is inferior to Xiao's composites in mechanical properties, and also lacks the enhanced corrosion rate in hot brine needed to be useful in gas and oil well operations. Thus, a POSITA would discount any information about AZ91D as disclosing anything of value with respect to strong, dissolvable magnesium alloys.

30. Paragraph [0026] of Xiao discloses the mechanism by which the corrosion decomposition of the "magnesium alloy with a high aluminum content (13 to 25% by weight) and

a high zinc content (2 to 10% by weight) ...” occurs. That mechanism is the formation of beta phase ($Mg_{17}Al_{12}$) regions on the grain boundaries of the magnesium alloy during eutectic freezing, which together with the alpha phase magnesium, functions as a large number of “micro-batteries, which greatly accelerate the corrosion decomposition of magnesium alloy.” The sole mention of the term “intermetallic” occurs later in paragraph [0026] where it is stated that “Elements 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.”

31. Table 1 compares the chemical composition of commercial magnesium alloy AZ91D to Xiao’s seven (7) example alloys. The examples all have added elements, for a total of up to eight different elements in one alloy. The maximum amount of any one added element (beyond the basic magnesium, aluminum, and zinc) is 5 wt. %. With so many elements in one alloy, there is no way to know or predict what phases might form. Phase diagrams with three elements are complex, phase diagrams with four or more phases do not generally exist, and phase diagrams for an alloy with eight elemental components are essentially impossible to determine. As a result, a POSITA would have no idea, based on thermodynamics or chemistry, as to what phases would exist in Xiao’s examples. Substantial experimentation would be required to even attempt to identify all the phases present, in terms of chemical composition, crystallographic structure, and electrochemical and thermodynamic properties.

Background of the Hassan Publication

32. Hassan describes the research to develop a simple two-element superior alternative to the commercial AZ91D-silicon carbide reinforced magnesium composite. The goal was to

develop a metal-metal composite (MMC) magnesium alloy with superior mechanical (strength and ductility) properties compared to the commercial alloy. As stated by Hassan, "The results further revealed that both engineering and specific 0.2% YS and UTS, and ductility of Mg/7.3Ni_p and Mg/14Ni_p composites remained much superior even when compared to the high strength magnesium AZ91D reinforced with much higher volume percentage of SiC_p." Notably, the words "corrode," "corrosion," "dissolve," and "dissolution" do not appear in this publication. The very first sentence of Hassan states, "The increasing hostile service conditions that the modern engineering devices have to withstand have led the materials scientist across the globe to create new materials with enhanced properties when compared to the conventional materials." A POSITA would understand "increasing hostile service conditions" to relate to extremes in temperature and to extremes in corrosive environments.

33. A POSITA would dismiss Hassan out of hand when looking for any information that would benefit the search for a strong dissolvable magnesium composite for use in oil and gas well development. Specifically, Hassan lists the strength of AZ91D with 15 volume % SiC particle reinforcement at 289 MPa, and presents the strength of his Mg-Ni particle composites as between 313 MPa and 463 MPa (significantly better than the best AZ91D composite), and in line with the strength of the Xiao Examples 1 through 7. Again, AZ91D is the commercial standard of comparison, and a POSITA would not be looking to Hassan for any information about AZ91D, which is the inferior alloy in Hassan. Hassan's system is a simple binary magnesium-nickel mixture, and to the extent that some thermodynamic reactions occur, such as the dissolution of part of the nickel and the formation of some Mg₂Ni particles, those reactions are easily understood via the common magnesium-nickel phase diagram. The minimum weight percentage of nickel disclosed by Hassan is 7.3 wt. %, and his magnesium mixtures contain no aluminum or zinc.

USPTO Reexamination Non-Final Rejection

34. Xiao does not disclose the claim element “in situ precipitation of galvanically-active intermetallic phases to enable controlled dissolution of said magnesium composite” (e.g., Claims 1, 4, 5, 12, 15, 20, 27, 31, 35, 39, 43, 47, 49, 61, 64, 73 and 74 of the ‘795 Reexam), nor does Xiao disclose the claim element “a secondary metal to form a galvanically-active intermetallic particle that promotes corrosion of said dissolvable magnesium composite, said secondary metal including on or more metals selected from the group consisting of copper, nickel ...” (e.g., Claims 25, 29, 33, 37, 41, and 45 of the ‘795 Reexam). Therefore, Xiao *cannot* anticipate any of the claims of the ‘795 Reexam.

35. Paragraph [0026] of Xiao states in part,

The present invention adopts 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 . . .

36. The highlighted language in the above quotation explains the necessity of having a high aluminum content – it is the aluminum that enhances corrosion. Xiao [0026] further states,

. . . in which the purpose of adding the high content of aluminum content 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 greatly accelerate the corrosion decomposition of magnesium alloy.

37. Xiao [0026] clearly discloses that the mode of fast corrosion of the magnesium alloy – at least 20 mg/cm²/hr. for the alloy of Xiao Claim 1 – is by the primary action of the micro-batteries formed from the main elements of the alloy, the magnesium and the aluminum. *This does not disclose or teach in any way a galvanically-active in situ precipitate created with a secondary*

metal. Instead, Xiao merely discloses a eutectic (formed during solidification) phase on the grain boundary, which is not a galvanically-active in situ precipitate created with a secondary metal as recited in the claims of the '795 Reexam. A POSITA in April 2014 would know that in metallurgy, precipitation refers to a reaction, wherein an intermetallic precipitate is nucleated when thermodynamically possible, and grows by diffusion of elements from the parent phase to the precipitate, as in the precipitation hardening of aluminum alloys. In the '795 Reexam, the inventor further defines in situ particle formation to include "The never melted particles . . ." that would remain if an elemental addition of a secondary material results in some of the particles remaining at least partially intact, never having melted or been absorbed into the molten magnesium or magnesium alloy. In requiring the eutectically formed $Mg_{17}Al_{12}$ - Mg micro-batteries, Xiao *teaches away* from the claims of the '795 Reexam which requires galvanically-active in situ precipitates formed between the magnesium alloy and the additive material, newly formed galvanically-active intermetallic particles incorporating a secondary metal, or un-melted remnants of elemental secondary metal additives.

38. The terms used in metallurgy, corrosion engineering, and chemistry that a POSITA would understand, including galvanic activity (the basis for all batteries and for galvanized steel, and for some basic forms of corrosion), and phase equilibria as promulgated via binary phase diagrams, such as those for Cu-Mg and Mg-Ni, which, along with all other phase diagrams considered herein, are attached as Exhibit C to this Declaration. In addition, the basic terminology in the art includes melting and freezing as two of the basic phase transformations, and the formation of new phases which are compounds of two elements. Because a POSITA would understand these terms, that POSITA would understand that Xiao *does not disclose, teach, or make obvious galvanically-active in situ precipitates, or a secondary metal to form a galvanically-active*

intermetallic particle. The '795 Reexam identifies Mg_2Cu and Mg_2Ni as examples of the galvanically-active precipitates or galvanically-active intermetallic particles. The phase diagrams for the Mg-Cu and Mg-Ni systems (included in Exhibit C) show that when copper is added to magnesium, Mg_2Cu is the first intermetallic compound to form. Similarly, when nickel is added to magnesium, Mg_2Ni is the first intermetallic compound to form.

39. Thus, in Claims 25, 29, 33, 37, 41, and 45 of the '795 Reexam that include the language of "a secondary metal to form a galvanically-active intermetallic particle that promotes corrosion of said dissolvable magnesium alloy composite" (emphasis added) would indicate to a POSITA familiar with phase diagrams that what would form in the case of a nickel secondary metal is Mg_2Ni , and what would form in the case of a copper secondary metal is Mg_2Cu , as described in the '795 Reexam. This is supported in Column 3, lines 13 – 15 of the '795 Reexam:

The never-melted particles and/or the newly formed secondary metallic alloys are referred to as in situ particle formation.

40. A POSITA would understand that an intermetallic compound is a special case of the reaction of two metals to form a specific stoichiometric compound with a specific chemistry and crystal structure. An intermetallic compound is differentiated from a binary metal alloy, which can have any arbitrary ratio of two metals. Copper and nickel, for example, can be combined in any ratio, and the resultant metal alloy will be a uniform solution of copper in nickel, or nickel in copper. No unique compounds with fixed chemistry or new crystallographic structures occur in the copper-nickel system.

41. In fact, Xiao Claim 1 has only the elements of magnesium, aluminum, and zinc, adding up to 100% of the alloy. No trace elements are *required* to "enable controlled dissolution

of said magnesium composite” or alloy, or “to form a galvanically-active intermetallic particle that promotes corrosion of said dissolvable magnesium composite.”

42. Claims 1, 12, 49, 73 and 74 of the ‘795 Reexam do NOT require a magnesium alloy as the basis of the magnesium composite. Such claims also claim magnesium (unalloyed) as a base material. The melting point of magnesium is 650°C. The intermediate alloys disclosed in Xiao [0036] and [0044] include Al-Fe, Al-Ni, Al-Ag, and Al-Cu. It is noted that the Ti and Zr additions in Xiao are described by Xiao as being present for grain refinement and for strength; in [0026] only Fe, Cu, Ni, and Ag are specifically identified as elements which CAN form intermetallic composite micro-particle, and which CAN improve the corrosion performance of the magnesium alloy.

43. The melting points of the intermediate alloys which a POSITA would choose are 548°C for Al-Cu, 566°C for Al-Ag, 640°C for Al-Ni, and 655°C for Al-Fe. The copper, silver, and nickel intermediate alloys with aluminum all have a melting point below the melting point of magnesium, so for those additive metals, Xiao does NOT disclose additive materials having greater melting points than the solidus temperature of magnesium.

44. With the high amounts of aluminum (13% to 25%) and zinc (1.3% to 10%) disclosed in Xiao’s examples, there is no guarantee that the additives iron, nickel, copper, and silver will form galvanically-active intermetallic phases. Xiao never discloses any of the compounds that might be formed by the iron, nickel, copper, or silver as “micro-batteries”; he reserves that description for the β ($\text{Mg}_{17}\text{Al}_{12}$) phase in conjunction with the magnesium-rich α phase.

45. The ‘795 Reexam is clear in that the in situ precipitated galvanically-active particles or the particles formed from specific secondary metals enable or promote the dissolution of the

magnesium composition in 3% KCl solution at 90°C. However, a POSITA looking at Tables 1 and 2 of Xiao would see that the presence of iron (Fe), copper (Cu), nickel (Ni), and silver (Ag) do NOT have a marked influence on the corrosion rate of the Xiao Examples 1 through 7.

46. Table A below shows the total amount of secondary elements (other than aluminum and zinc) in the seven Xiao examples, along with the corrosion rate in 3% KCl solution at 93°C. The seven Xiao examples are sorted by total amount of secondary elements from smallest to largest in this table:

	weight % Sum of elements Fe, Ni, Cu, Ag, Ti, and Zr	Decomposition Rate in 3% KCl at 93°C mg/cm ² -hr
Example 2	0.8	45
Example 5	1.05	48
Example 7	2.15	57
Example 6	4.95	63
Example 1	8.6	74
Example 4	10.9	58
Example 3	15.5	36

Table A. Secondary element concentrations and dissolution rates of Xiao Examples 1 through 7, sorted by sum of secondary elements
Source: Xiao Tables 1 and 2

47. The example with the highest concentration of secondary elements (Example 3) actually has the lowest dissolution rate. A POSITA would notice that there is no correlation between the sum of the secondary elements in the examples and the dissolution rate of those examples, confirming only that the secondary elements can affect the dissolution rate of the Magnesium-Aluminum-Zinc alloy of Xiao, NOT that they will enhance and control the dissolution

rate as claimed in the '795 Reexam. They certainly do not enable the dissolution of the Xiao magnesium composites as claimed in independent Claims 1, 12, 49, 73, and 74 of the '795 Reexam.

48. Xiao [0026] further states:

Elements 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.

49. This sentence in Xiao does not teach or disclose the '795 Reexam's claimed "in situ precipitation of galvanically-active intermetallic phases to enable controlled dissolution of said magnesium composite" or the claimed "secondary metal to form a galvanically-active intermetallic particle that promotes corrosion of said magnesium alloy composite." Xiao emphasizes that the aggregate of micro-batteries formed between the beta phase ($Mg_{17}Al_{12}$) and the alpha phase magnesium is the basis for promoting decomposition of the magnesium alloy. The aluminum in the beta phase is NOT an in situ precipitated galvanically-active intermetallic phase as claimed in the '795 Reexam. This is because in Claim 1 of the '795 Reexam, for example, the limitation is "said additive material forming precipitant in said magnesium composite", and the "additive material must include one or more metals selected from the group *consisting of* copper, nickel, iron, and cobalt." In contrast to "comprising," "consisting of" is closed and means that the invention is only what is described. Thus, aluminum is NOT an additive material as defined in Claim 1 of the '795 Reexam, but is a component of the magnesium alloy.

50. In the same sentence, Xiao does *not* disclose either an "in situ" or a "galvanically-active" precipitate. Instead, that sentence merely states that "Elements 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." Nothing in this sentence would lead a POSITA to the conclusion that either an "in situ" precipitate or a "galvanically-

active” precipitate would be formed. In fact, I emphasize that the verb “can” appears in two places in that sentence, which would mean to a POSITA that those additive elements do not necessarily form intermetallic particles, do not form either in situ or galvanically-active precipitates, and that those elements do not necessarily improve the corrosion performance of the magnesium alloy. This sentence in Xiao [0026] merely says that if the Fe, Cu, Ni, Ag, etc. happen to form intermetallic composite micro-particles, and if those micro-particles happen to improve the corrosion performance, only then do Fe, Cu, Ni, Ag, etc. promote decomposition of the magnesium alloy. Xiao is silent as to the galvanic-activity of the micro-particles (if any), so Xiao does not teach or disclose galvanically-active intermetallic particles. The limitation of Claim 1 of the ‘795 Reexam is that in that invention these additive materials DO form galvanically-active in situ precipitated intermetallic particles that ARE necessary to “enable” or allow controlled dissolution of said magnesium composite.

51. In my opinion, a POSITA would not recognize, in the alloy system disclosed in Xiao, that the reaction between magnesium and the metals in the additive material would necessarily form galvanically-active intermetallic particles. With the high amounts of aluminum and zinc in the alloy (both of which are very reactive metals), incorrect hindsight analysis combined with significant experimentation and evaluation would be required to determine what compounds, if any, would form between iron, copper, nickel, or cobalt and the components of the magnesium alloys disclosed by Xiao. A POSITA would not reach such a conclusion in reading that same sentence.

52. As stated above, multicomponent phase diagrams for more than five (5) elements in an alloy do not exist so, short of substantial experimentation and with no certainty of success,

what phases might form in the Xiao example alloys is unknown; hence, Xiao cannot disclose in situ precipitation or formation of galvanically-active intermetallic compounds.

53. A POSITA reading the sentence from Xiao [0026] quoted in paragraph 48 above would be at a loss to know that iron, copper, nickel, silver, etc., would react within the magnesium alloy to precipitate galvanically-active particles that would enable controlled dissolution (i.e., in their absence, controlled dissolution would not occur) of the magnesium alloy. In addition, a POSITA would not know what the mechanism of improved corrosion performance that “can” (i.e., might) be promoted by the elements iron, copper, nickel, silver, etc., would be. Those elements might promote a different grain boundary morphology to enable the $Mg_{17}Al_{12}$ – Mg micro-batteries to perform better. Those elements might induce porosity which may allow a brine solution better access to the MgAl – Mg micro-batteries. Those elements might modify the $Mg_{17}Al_{12}$ phase or the Mg phase to increase the electrochemical potential difference between those phases, improving corrosion performance. Those elements might promote dissolution of the corrosion products of the $Mg_{17}Al_{12}$ – Mg micro-batteries, preventing interruption of the corrosion by passive films of corrosion product. Significant experimentation would be required to ascertain the truth of any of these conjectures. Again, I believe that a POSITA reading this teaching in Xiao would readily reach a very different conclusion than what is set forth in the ‘795 Reexam claims. The simple analysis showing a lack of correlation between Xiao’s amount of secondary additives and the dissolution rate of those examples is the best evidence that Xiao has not disclosed that the secondary additives iron, copper, iron, or silver enable or promote the dissolution of Xiao’s magnesium composite examples.

54. With Xiao’s emphasis on the many micro-batteries formed between significant amounts of beta phase ($Mg_{17}Al_{12}$) and alpha phase magnesium, Xiao also teaches away from the

use of the trace elements of iron, copper, nickel, or cobalt to necessarily enable controlled dissolution of magnesium alloys or to create an in situ or galvanically-active precipitate with those elements. Instead, a POSITA would understand that Xiao emphasizes the $\text{Mg}_{17}\text{Al}_{12}$ – Mg micro-batteries as the dominant mode of dissolution in his alloys.

55. Dr. Medlin analyzes Xiao only Claim 1, which discloses a range of magnesium percentage in a composite from 60% to 85%, and states that this reference in Xiao discloses the range of magnesium in Claim 25 of the '795 Reexam, "at least 85 wt. % magnesium." However this is misleading in that all the claims of the '795 Reexam require elements in addition to aluminum and magnesium; hence, Xiao's Claim 1 does not disclose any of the compositions of the '795 Reexam. The seven examples in Xiao's Table 1 [0062] have aluminum compositions ranging from 54.5 wt. % to 79.1 wt. %. Thus, there is no overlap in the range of magnesium disclosed in Xiao's seven examples and the range of magnesium (at least 85%) claimed in Claims 25, 55, and 74 of the '795 Reexam; hence, there is no disclosure of the claimed range in Xiao's seven examples. The magnesium alloy of Xiao's Claim 1 is not even listed in Table 1 [0062] or Table 2 [0064] of Xiao, so a POSITA can only infer that the dissolution rate of this Mg-Al-Zn alloy is greater than 20 mg/cm²/hr. Xiao Claims 2 and 3 encompass the seven examples in his tables. Further, a POSITA would read Xiao's method claims (Claim 4 through Claim 10), all of which require adding the trace elements in addition to the aluminum and the zinc to the magnesium, and understand that Claim 1 merely claims the basic alloy from which his seven listed examples are made, via the addition of the trace elements Fe, Cu, Ni, and Ag. The seven examples with specific dissolution rates listed in Table 2 [0064] are what a POSITA would see as the actual teaching of Xiao, and that Xiao is not teaching an alloy with 85% magnesium as anything other than a starting point for his actual magnesium dissolvable alloys.

56. Commercial magnesium alloy AZ91D is the inferior prior art that Xiao is improving upon, thus it does not disclose as desirable the type and range of additive materials (specifically, aluminum, zinc, zirconium, or manganese) claimed in Claim 75 of the '795 Reexam. Claim 75 is dependent on Claim 74, which requires the addition of copper, nickel, or cobalt to create in situ precipitation of galvanically-active intermetallic phases. The resulting magnesium composite will have a dissolution rate in 3% KCl at 90°C of at least 84 mg/cm²/hr., far in excess of the dissolution of unmodified AZ91D with a dissolution rate under the same conditions of only ½ mg/cm²/hr. The highest dissolution rate disclosed by Xiao is 74 mg/cm²/hr. for Example 1, which has 13 wt. % aluminum, the minimum necessary to create Mg₁₇Al₁₂ – Mg micro-batteries. Because Xiao teaches that the AZ91D alloy as *unsuitable*, due to its very low rate of dissolution in 3% KCl at 93°C, for dissolvable magnesium composite applications, a POSITA would not accept the type and range of elements in AZ91D as being recommended for an improved dissolvable magnesium composite. Indeed, Xiao provides a comparative examples, with at least 13 wt. % aluminum, that utilize different elements at different ranges. Those counter examples are what Xiao discloses to a POSITA seeking improved dissolvable magnesium composites for service in gas and oil well production.

57. Further, Xiao does not teach or disclose any modification or addition to AZ91D to increase its rate of dissolution to exceed his minimum of 20 mg/cm²/hr., which would require increasing the dissolution rate of AZ91D by a factor of 40. As is discussed further in paragraph 59 below, reference to the Al – Mg phase diagram (included in Exhibit C to this Declaration) shows that at least 13 wt. % aluminum is required to form the Mg₁₇Al₁₂ – Mg micro-batteries common to all of Xiao's examples and to his Claim 1.

58. Dr. Medlin's opinion that Xiao discloses heat treatment to improve hardness is incorrect. Dr. Medlin claims that a U.S. Patent discussed as prior art within Xiao discloses sintering, which should lead a POSITA to the heat treatment to improve surface hardness required by the '795 Reexam Claim 8. Xiao itself does not discuss, explain, improve upon, or disclose heat treatment to improve surface hardness. Xiao actually *teaches away* from heat treatment because, just two sentences later in Xiao's specification, Xiao provides: "However, the above method requires plating ... which would greatly increase the production of the material and thus cannot be industrially produced." Xiao does not disclose or make obvious this claim limitation of the '795 Reexam. A POSITA would know that sintering is a thermal process causing particles of metal powder pressed together at low temperature to bond to each other by atomic diffusion at temperatures below the melting point of the metal powder. A POSITA would know that sintering is not a surface hardening treatment and is in no way related to true surface hardening treatments such as carburizing, nitriding, flame hardening, or induction hardening.

59. Regarding Claim 33 of the '795 Reexam, Xiao Claim 1 in conjunction with Xiao's Table 1 [0062] discloses a range of aluminum between 13% and 25%. This range is important because all those compositions lie on the eutectic temperature between magnesium and aluminum and promote the formation of the beta phase ($Mg_{17}Al_{12}$) by the eutectic reaction. The '795 Reexam claim 33 requires at most 10 wt. % aluminum, sufficiently away from the eutectic region to preclude formation of the beta phase ($Mg_{17}Al_{12}$). To state that 10 wt. % aluminum is close to the amount disclosed in Xiao is incorrect since the Al – Mg phase diagram (included in Exhibit C to this Declaration) shows that for less than 10 wt. % aluminum, the liquid will freeze into a uniform magnesium phase with the aluminum in solid solution, and not create the eutectic structure required by all of Xiao's claims and examples. At such a low aluminum weight percent, the

Mg₁₇Al₁₂ – Mg micro-batteries will not form in the alloy, thus further teaching away from any Mg alloy having an aluminum composition of less than 13 wt. %. The commercial AZ91D alloy, with 9 wt. % aluminum and a low dissolution rate of ½ mg/cm²/hr., is criticized by Xiao as being unsuitable for a dissolvable magnesium composite. Therefore, since it is unsuitable, it does not disclose a magnesium composite with the required dissolution rate.

60. Regarding Claim 58, dependent on Claim 49, the previous discussion for Claim 33 is equally applicable. Xiao's examples with aluminum wt. % of 13 to 25 do NOT overlap the 0.5 – 10 wt. % of Claim 58, and because of the Mg – Al phase diagram eutectic, which allows the formation of Mg₁₇Al₁₂ to create micro-batteries only above 13 wt. % aluminum, a completely different product is formed on freezing of the molten composite. The Mg – Al phase diagram is included in Exhibit C to this Declaration.

61. Regarding Claim 74 of the '795 Reexam, consider Example 1 of Xiao which has the highest dissolution rate of any of his seven examples, 74 mg/cm²/hr. Upon adding up all the components of Xiao Example 1, the balance of magnesium is 77.1 wt. %, nowhere near the at least 85 wt.% magnesium limitation in Claim 74. Example 1 has the third highest combined non-aluminum non-zinc additives (8.6 wt. %), and also has the highest dissolution rate of any of Xiao's examples (74 mg/cm²/hr.). This rate is well below the lower limit of the claimed dissolution rate in Claim 74 of at least 84 mg/cm²/hr. and up to 325 mg/cm²/hr. If a POSITA were to look at the dissolution rates of the other Xiao examples, that POSITA would be discouraged from trying to achieve a higher dissolution rate with minor modifications, since all the other Xiao examples have a dissolution rate LESS than that of Example 1. A POSITA would not believe from the teachings of Xiao that a version of Xiao's magnesium alloy examples could achieve dissolution rates of at least 84 mg/cm²/hr. as required in claim 74 of the '795 Reexam.

62. Regarding Claim 26 of the '795 Reexam, which claims a dissolution rate of at least 100 mg/cm²/hr., the results that Xiao presents in his Table 2 [0064] show that a wide variation in additive composition, from a total of 0.8 wt. % for Example 2 to a maximum of 15.5 wt. % for Example 3, results in a narrow range of dissolutions, from 36 mg/cm²/hr. to 74 mg/cm²/hr., only about a two-to-one ratio for highest to lowest, and less than one-fourth of the highest dissolution rate claimed in the '795 Reexam. A POSITA would understand that the Mg₁₇Al₁₂ – Mg micro-batteries disclosed by Xiao are the major determinant of the rates of dissolution of Xiao's seven example magnesium alloys. A POSITA would not believe from the teachings of Xiao that the magnesium alloys disclosed by Xiao could achieve dissolution rates of at least 100 mg/cm²/hr. as required in Claim 26.

63. Again regarding Claim 33 of the '795 Reexam, commercial alloy AZ91D has Mg, Al, Zn and Mn within the ranges claimed in Claim 33. AZ91D does not have the claimed secondary metal selected from the group consisting of copper, nickel, cobalt, titanium, and iron. Note that the range of aluminum claimed in Claim 33 is 0.5 – 10 wt. %, below the minimum of 13 wt. % aluminum necessary to form Xiao's Mg₁₇Al₁₂ – Mg micro-batteries. However, commercial alloy AZ91D does not anticipate Claim 33 since it does not contain the required element of the secondary metal. Because the dissolution rate given by Xiao is ½ mg/cm²/hr., AZ91D does not have a dissolution rate of at least 5 mg/cm²/hr. Xiao would be a POSITA, but he was not motivated to augment commercial AZ91D with his additives of Fe, Ni, Cu or Ag to make a fast-decomposing magnesium composite. In his experiments, Xiao found that he needed at least 13 wt.% aluminum (and preferably more) to create the beta phase (Mg₁₇Al₁₂) to be the cathode to the magnesium alloy anode. A POSITA would see that Xiao did not mention augmented AZ91D as a possible fast-dissolving magnesium composite. A POSITA consulting the Al – Mg phase diagram (included in

Exhibit C to this Declaration) would immediately see that a minimum of 13 wt. % aluminum in magnesium is required to create the micro-batteries that Xiao describes as the basic component of the Xiao invention. Since Claim 33 requires 0.5 - 10 wt.% aluminum, Xiao would not teach a POSITA that a successful dissolvable magnesium alloy could be formed with an aluminum content of less than 13 wt.%.

64. Regarding Claim 58 of the '795 Reexam, which is limited to 0.5 – 10 wt. % aluminum, the analysis in the previous paragraph concerning Claim 33 is equally applicable. Commercial magnesium alloy AZ91D, with 9 wt. % aluminum was the inferior comparative example chosen by Xiao for contrast with his high aluminum alloys (13 wt. % to 25 wt. % aluminum) which he found had dissolution rates at least 70 times higher than that of AZ91D. A POSITA consulting the Al – Mg phase diagram, included in Exhibit C to this declaration, would immediately see that a minimum of 13 wt. % aluminum in magnesium is required to create the micro-batteries that Xiao describes as the basic component of the Xiao invention. Since Claims 58 requires 0.5 - 10 wt.% aluminum, Xiao would not teach a POSITA that a successful dissolvable magnesium alloy could be formed with an aluminum content of less than 13 wt.%.

65. In summary, it is my opinion, based on the analysis presented above, that Xiao does not anticipate or make obvious any of the asserted claims of the '795 Reexam.

Analysis of Xiao in view of Hassan

66. Xiao in view of Hassan does not disclose or make obvious a controlled dissolvable magnesium alloy with in situ precipitated or formed galvanically-active particles as recited in the '795 Reexam claims. As described above, Xiao does not disclose or make obvious any in situ

precipitated or formed galvanically-active particles as recited in the '795 Reexam claims. As such, even the combination of Xiao with Hassan cannot make the '795 Reexam claims obvious.

67. Dr. Medlin has made no attempt to demonstrate a motivation to combine the Xiao and Hassan references, especially when Hassan teaches away from and describes a different art than Xiao. It is my opinion that a POSITA would not have looked from Xiao to Hassan, and would not have combined them.

68. Hassan describes simple binary composites with only magnesium and at least 7.3 wt. % nickel, no aluminum, and no zinc. A POSITA, wishing to improve the Xiao alloys, (which have at least 13 wt. % aluminum and at least 1.3 wt. % zinc, and up to eight total elements in a thermodynamically indecipherable complex of unknown phases) would NOT look to Hassan, with no aluminum or zinc, for any ideas for improving the Xiao alloys. The Xiao magnesium alloys all require at least 13 wt. % aluminum to form $Mg_{17}Al_{12}$ – Mg micro-batteries to achieve dissolution rates in excess of 20 mg/cm²/hr.

69. Hassan teaches, to a POSITA, that elemental nickel particles can be distributed within a mass of magnesium turnings, and melted into a slurry of molten magnesium and solid nickel particles, which can then be atomized into magnesium powder with entrained elemental nickel particles. The powder can be consolidated and then extruded into a metal matrix composite that is reinforced by nickel particles that never melted. As such, it does not teach the intentional formation of in situ precipitates (e.g., Mg_2Ni) or un-melted nickel particles as galvanically-active enablers or promoters of corrosion and dissolution.

70. Dr. Medlin looks to Hassan using impermissible hindsight to find a reference that mentions in passing the existence of small Mg_2Ni particles, so that he can add those small Mg_2Ni

particles to Xiao. The difficulty is that at the time of the invention, a POSITA would have had no motivation to look to Hassan for any improvement in the examples of Xiao.

71. For example, contrary to Dr. Medlin's opinion, a POSITA would not have looked from Xiao to Hassan to make obvious the deformation processing of Claim 7. Hassan discloses no deformation processing to reduce grain size; in fact, Hassan does not even discuss grain size. The only microstructural observation was that a significant fraction of each nickel particle was melted into the magnesium, resulting in final nickel particle sizes on the order of one-tenth the diameter of the original nickel particles. Since the mechanical strength of the Xiao examples (360 MPa to 410 MPa), overlaps the mechanical strengths of the Hassan composites (313 MPa to 463 MPa), and both are well in excess of the non-dissolving AZ91D magnesium alloy (232 MPa to 258 MPa), a POSITA would not look to Hassan to provide a mechanism to improve the strength of the Xiao examples, which are adequate for their intended purposes.

72. What Hassan does describe is summarized at the beginning of his paper:

1. Introduction

The increasing hostile service conditions that the modern engineering devices have to withstand have led the materials scientist 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.

73. The goal of Hassan was to create a metal matrix composite to withstand "increasing hostile service conditions," with only two components, the magnesium matrix and the nickel particulate reinforcing phase. Withstanding "hostile service conditions" would tell a POSITA that Hassan's composites are able to withstand the two main components of hostile environments -- higher temperatures and corrosive environments. Hassan's composites that are resistant to

corrosion, in “increasing hostile environments”, would not attract the attention of a POSITA looking to improve and control the rate of dissolution of a magnesium composite in hot brine.

74. To a POSITA, Hassan attempted to keep as much nickel as possible in elemental particle form to maximize the strengthening effect of the nickel particles. The formation of magnesium-nickel intermetallic compounds at the surface of the nickel particles, via a diffusion mechanism, aided in developing and maintaining coherence between the face-centered-cubic crystallographic structure of the nickel particles and the hexagonal-close-packed crystallographic structure of the magnesium matrix.

75. In fact, Hassan actually teaches away from the ‘795 Reexam, in that it is directed at a completely different art -- the art of developing high-strength and ductile structural alloys to take advantage of the light weight and low density of magnesium. It is my opinion, for the reasons stated above, that the asserted claims of the ‘795 Reexam are not anticipated by Hassan, and that Hassan does not render the asserted claims of the ‘795 Reexam invalid due to obviousness, even in light of Xiao.

76. As noted above, the words “corrode”, “corrosion”, “dissolve” and “dissolution” do not appear in Hassan (let alone accelerated dissolution rates), which is a very strong basis that a POSITA would not read this publication as teaching a dissolvable Mg alloy. If anything, Hassan would have been irrelevant since the binary phase diagram for the magnesium-nickel system has, since at least 1908, shown that one of the equilibrium intermetallic compounds in this system is Mg_2Ni . A POSITA would not need to refer to Hassan to learn that this intermetallic compound will form under the proper thermodynamic conditions.

77. Similarly, a POSITA would not look to the Hassan publication to find information about controlled corrosion rates of magnesium-nickel composite materials. Hassan, with its

emphasis on enhanced strength and ductility for mechanical strength in hostile environments, teaches away from dissolvable magnesium alloys.

78. Dr. Medlin also improperly applies hindsight analysis to combine Xiao and the unreacted nickel of Hassan. Because Xiao does not disclose galvanically-active in situ precipitate, the combination of Xiao and Hassan does not make in situ precipitation of galvanically-active intermetallic phases that include unreacted nickel. Dr. Medlin makes no attempt to explain why the nickel remains unreacted under Hassan such that it would also remain unreacted in any combined application with Xiao. Dr. Medlin provides no experimentation or analysis suggesting why a POSITA in April 2014 would have made the leap from Xiao's non-disclosure to Hassan's particular result of unreacted nickel to the '795 Reexam as set forth in claims 12 and 71. Without this explanation or experimentation, Dr. Medlin's opinion is unsupported.

79. Regarding Claim 7 of the '795 Reexam, Hassan teaches the extrusion of the composite created by the disintegrated melt deposition technique (basically a powder metallurgy process) was performed to eliminate the porosity in the melt deposit which had been atomized from the liquid by argon gas. The extrusion did not affect the size of the nickel particles in the final product; the loss of a portion of the nickel from the surface of the nickel particles by the action of the molten magnesium reduced the particle size of the solid, unmelted nickel. The "improvement in mechanical properties" was in comparison to magnesium reinforced with silicon carbide particles. Hassan concluded that the good bonding of the nickel to the magnesium made it a more effective reinforcing phase than the poorly bonded silicon carbide. The extrusion had nothing to do with the measured mechanical properties of the resulting products, and a POSITA reading Hassan would have realized that. In fact, Hassan does not measure the mechanical properties of the pre-extrusion composites, and thus makes no comparison of the mechanical

properties of his composites before and after extrusion. Thus, Hassan is in no way disclosing any improvement in mechanical properties of his binary magnesium-nickel composites due to extrusion.

80. Regarding Claim 12 of the '795 Reexam, Hassan does describe very specific conditions under which molten magnesium, along with the elemental nickel powder included with the magnesium, and drained out of an orifice in the bottom of a crucible, and atomized to powder with argon gas, and collected for further consolidation, can keep a small fraction of the nickel in unmelted elemental form. But all of this complicated fabrication is for the purpose of making strong magnesium alloys for use in increasingly hostile environments, not for making a fast-dissolving magnesium composite.

81. Regarding Claim 71 of the '795 Reexam, a similar analysis to the previous paragraph discussing Claim 12 applies. Hassan does not teach that nickel additions WILL remain unreacted and unalloyed; to the contrary, Hassan teaches that the nickel particles will react with the molten magnesium to create the intermetallic intermediary phase that results in good bonding of the nickel to the magnesium. Hassan also teaches that extraordinary fabrications, techniques including combining the solid magnesium with the solid nickel *prior* to melting the magnesium, assisted by vigorous stirring and gas purging to keep the nickel in uniform suspension and to minimize gas porosity. This stirred mixture of molten magnesium and solid nickel particles is then atomized by argon gas jets impinging on a stream of molten material released through an orifice in the bottom of a crucible. The solidification of the atomized mixture droplets freezes the nickel particles in an even distribution in the magnesium. Extrusion is then required to consolidate the collected powder compact to reduce geometric porosity. The extrusion of Hassan was conducted at 400°C, a significant fraction of the melting point of the magnesium which a POSTIA would

recognize as resulting in immediate recrystallization of the magnesium after extrusion, such that the extrusion would have no result in reducing the grain size of the magnesium matrix. Indeed, Hassan did not even report the grain size of the magnesium matrix, only the diameter of the final nickel particles.

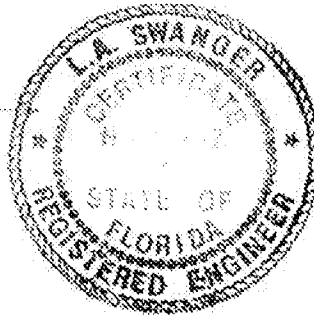
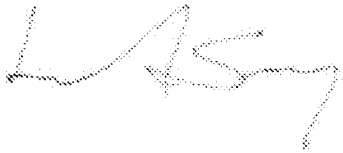
82. Regarding Claim 13 (dependent on product Claim 12) of the '795 Reexam, this claim further limits the product in Claim 12 with regard to the solidus temperature of the molten magnesium or magnesium alloy being below the melting point of the additive material to result in a magnesium composite wherein some of the additive material remains unalloyed. A POSITA would recognize this is best done with elemental additions of the additive material in controlled particle sizes (described in the specification of the '795 Reexam, column 2, lines 39 – 53), resulting in a particular structure in the product, namely the un-melted, 10 to 50 micron particles of the additive material. In contrast, method Claim 4 of Xiao describes a melting procedure in which the intermediate alloys of trace elements, not the pure element, are added to the molten magnesium aluminum alloy, "increasing the temperature for melting, refining, degassing, waiting for a while and then casting in a protective atmosphere." A POSITA would recognize the Xiao Claim 4 method as one to guarantee complete dissolution of the components of the intermediate alloys of the trace element components, precluding the un-melted particles claimed in Claim 13 of the '795 Reexam. A POSITA would not look to Hassan for a dissolvable magnesium alloy with un-melted nickel particles, because Hassan touts his composites as able to withstand increasingly hostile conditions. Thus, Xiao does not anticipate Claim 13 of the '795 Reexam and Xiao in light of Hassan does not make obvious claim 13 of the '753 Reexam.

83. It is my opinion, supported by the analysis above, within a reasonable degree of scientific certainty, that Xiao in view of Hassan does not render obvious any of the claims of the '795 Reexam.

84. Had Dr. Medlin conducted a complete obviousness analysis, he would have discovered that there was a long-felt need for a higher strength dissolvable oil and gas fracking tool to overcome the limitations of the polymeric tools requiring mechanical removal, and the tools made via powder-metallurgy which were deficient in strength prior to dissolution. He would have found that fracking in the oil and gas exploration and development industry has existed for many decades, and the major oil companies and their servicing suppliers (such as Halliburton and Schlumberger) would have long ago created the magnesium composites such as those described in the '795 Reexam if they were obvious, which they are not. Dr. Medlin would also have learned of the great commercial success for the patented products, as shown by the rapid expansion of the business and the ability to command premium prices in the marketplace, until copying of the patented magnesium composites occurred, which is all detailed in the Declaration of Andrew J. Sherman Under 37 C.F.R. §1.132 filed in this Ex Parte Reexamination. Mr. Sherman also testified in his Declaration about specific documents and information that specifically established long-felt need of this invention in the fracking industry, and praise by others once his team invented their dissolvable magnesium. (Sherman Declaration at ¶¶ 18 - 24). For example, Mr. Sherman and his team received a number of recognitions for their invention. (Sherman Declaration at ¶ 31). Mr. Sherman also described how the greatly increased dissolution rate in a strong, ductile magnesium composite with very low concentrations of nickel and/or copper was an unexpected result (Sherman Declaration at ¶¶ 31 - 36). Again, Dr. Medlin never addressed this non-obviousness factor, let alone facts that strongly show it supporting non-obviousness.

Attestation: By affixing my signature and seal below, I certify that this declaration truthfully presents the results of my analyses, and the conclusions and opinions, which I hold to at least a reasonable degree of scientific and engineering probability, that I have reached based on those analyses. I declare that the foregoing is true and correct.

Respectfully submitted,



Lee A. Swanger, Ph.D., P.E.
Principal Engineer, Exponent, Inc.
Date: January 14, 2022

Attachments: Exhibits A-C

Exhibit A



Exponent[®]

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Professional Profile

Dr. Swanger is the Director of Exponent's Miami, Florida, office. His consulting work centers on the application of the principles of mechanical engineering, metallurgical and materials engineering, thermodynamics, and design engineering to issues related to incidents involving performance of engineered products and systems, accident reconstruction, and failure or fracture of system components. He also consults on issues of patent infringement and patent validity in the mechanical and materials arts. More specifically, Dr. Swanger's experience includes the analysis of machinery dynamics and kinetics as exemplified by internal combustion engines of both piston and turbine configuration, as well as related compressor designs. His materials and metallurgical experience includes alloy applications, heat treatment, electrochemistry and corrosion, welding and brazing, and materials testing. He applies his combined expertise in both mechanical engineering and materials/metallurgical engineering to issues of fatigue and fracture, and mechanical joining via threaded fasteners.

Applications of these disciplines include systems in nuclear and fossil power plants, components of transportation systems on land, sea, and air, industrial manufacturing processes, components of commercial and residential buildings, materials used in the petroleum and chemical industries, machinery and processes for vapor degreasing and dry cleaning, and consumer products including sports equipment and kitchen appliances.

Dr. Swanger has a particular interest in engine design and performance, with an emphasis on combustion, operational stresses, lubrication and bearing design and performance. He received a U.S. Patent for his engine bearing material and fabrication process.

Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, Stanford University, *with distinction*, 1972

M.B.A., Marketing/Finance, Cleveland State University, 1982

M.S., Materials Science and Engineering, Stanford University, 1969

B.S., Metallurgy, Case Institute of Technology, *with highest honors*, 1968

Hertz Foundation Graduate Fellowship, 1970-1972

Member, Board of Directors of the Fannie and John Hertz Foundation

Licenses and Certifications

Licensed Professional Engineer, Alabama, #29848-E

Licensed Professional Mechanical Engineer, California, #M23275

Licensed Professional Engineer, Florida, #37207

Licensed Professional Engineer, Georgia, #PE036205

Licensed Metallurgical Engineer, Louisiana, #34064

Licensed Professional Engineer, Mississippi, #25349

Licensed Professional Engineer, New York, #93691

Licensed Professional Metallurgical Engineer, Ohio, #44024

Licensed Professional Engineer, Virginia, #15492

Licensed Mechanical Engineer, Wyoming, #11899

Prior Experience

Adjunct Professor, Mechanical Engineering Department, University of Miami, 1999-2008

Director of Research and Development, Engine Parts Division, Imperial Clevite, 1979-1983

Lecturer, Mechanical Engineering Department, Cleveland State University, 1978-1982

Project Manager, Gould Labs for Materials Research, Gould Inc., 1975-1979

Associate Sr. Research Metallurgist, General Motors Research Labs, 1973-1975

Patents

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Swanger L. Expert Report on Rebuttal of January 26, 2007 "Expert Report of Elliot L. Stern, Ph.D., On The Invalidity of U.S. Patent Nos. 6,260,780 And 7,040,559" Pursuant To Rule 26(A)(2)(B) by Lee A. Swanger, Ph.D., P.E., Fellowes, Inc. vs. Michilin Prosperity Company Ltd. & Intek America, Inc., February 26, 2007.

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Exhibit B

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF OHIO
EASTERN DIVISION

TERVES LLC,	)	
	)	CASE NO.: 1:19-CV-1611
Plaintiff,	)	
	)	
v.	)	JUDGE DONALD C. NUGENT
	)	
YUEYANG AEROSPACE NEW MATERIALS	)	
CO., LTD. <i>et al.</i> ,	)	
	)	<u>MEMORANDUM OPINION</u>
Defendants.	)	<u>AND ORDER</u>
	)	

This matter is before the Court for claim construction. The parties have filed opposing Opening Claim Construction Briefs and Responses in support of their respective interpretations of disputed terms (ECF # 36, 37, 45, 46). The Court has heard oral arguments on the issue, and the parties filed a post-hearing Joint Notice of agreement on certain disputed terms. (ECF #83, 86). The issues are now fully briefed and ripe for consideration.

FACTUAL AND PROCEDURAL HISTORY

Terves LLC ("Terves") filed this action against Yueyang Aerospace New Materials Co., ("Yueyang"), Ecometal Inc., and Nick Yuan alleging violations of three U.S. Patents, Numbers 9,903,010 ("the '010 Patent"), 10,329,653 ("the '653 Patent"), and 10,689,740 ("the '740 Patent"). The Patents relate to dissolvable magnesium materials for use as components in oil drilling. Originally Terves contended that none of the patent terms require court construction. Ecometal and

Mr. Yuan (collectively “Ecometal”), on the other hand, submitted several terms for construction. Throughout the course of these proceedings the parties convened and came to an agreement on the meaning of several of the originally disputed terms. There now remain seven terms that Ecometal is asking the Court to construe.

LEGAL STANDARD

In order to determine the proper construction of disputed claims, the Court must look to several sources identified by the Patent Act, and by those Federal Courts that have interpreted and clarified the requirements of the Act. However, non-technical terms may not require elaborate interpretation. *See Brown v. 3M*, 265 F.3d 1349, 1352 (Fed. Cir. 2001). “The criterion [for claim construction] is whether the explanation aids the court and the jury in understanding the term as it is used in the claimed invention.” *Funai Elec. Co. V. Daewoo Elecs. Corp.*, 616 F.3d 1357, 1366-67 (Fed. Cir. 2010).

“It is a ‘bedrock principle’ of patent law that ‘the claims of a patent define the invention to which the patentee is entitled the right to exclude.’” *Philips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005)(quoting *Innova/Pure Water, Inc. v. Safari Water Filtration Systems, Inc.*, 381 F.3d 1111 (Fed. Cir. 2004); see also *Vitronics Corp. v. Conceptiontronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)(“we look to the words of the claims themselves . . . to define the scope of the patented invention”). Further, although Congress has required that a patent specification should include a segment wherein the inventor “shall particularly specify and point out the part, improvement, or combination, which he claims as his own invention or discovery,” (Act of July 4, 1836, ch. 357, § 6, 5 Stat. 117, 119), the Supreme Court has long since made clear that the claims themselves are “of

primary importance, in the effort to ascertain precisely what it is that is patented.” *Merrill v. Yeomans*, 94 U.S. 568, 570 (1876); *see also, e.g., White v. Dunbar*, 119 U.S. 47, 52 (1886); *Aro Mfg. Co. v. Convertible Top Replacement Co.*, 365 U.S. 336, 339 (1961).

In determining what a claim means, the Federal Circuit has repeatedly held that the words of the claim are generally to be given their ordinary and customary meaning, and has defined “ordinary and customary meaning” as “the meaning that the term would have to a person of ordinary skill in the art in question” at the time of the effective filing date of the patent application. *Philips*, 415 F.3d at 1312-13 (citations omitted). A person of ordinary skill in the art is presumed to have read the claim not only in the context of the particular claim containing the disputed term, but in the context of the entire patent, including the specification, and with knowledge of the prosecution history. *Multiform Desiccants, Inc. v. Medzan, Ltd.*, 133 F.3d 1473, 1477 (Fed. Cir. 1998).

The specification is “the single best guide to the meaning of a disputed term,” and the specification “acts as a dictionary when it expressly defines terms used in the claims or when it defines terms by implication.” *Philips* at 1320 (quoting *Vitronics*, 90 F.3d at 1582; *Irdeto Access, Inc. v. Echostar Satellite Corp.*, 383 F.3d 1295, 1300 (Fed. Cir. 2004)). Section 112 of the Patent Act, 35 U.S.C. § 112, states that the specification

shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains ... to make and use the same... [and] ... shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Although reference to the specification is potentially highly useful in construing or defining specific terms, or in providing context to terms within the individual claims, the Federal Circuit has warned courts against reading limitations from the specification, most especially from the description of

specific or preferred embodiments, into an individual claim. *Philips* at 1322; *Texas Digital Systems, Inc. v. Telegenix, Inc.*, 308 F.3d 1193 (Fed. Cir. 2002); *Nazomi Communications, Inc. v. ARM Holdings, PLC*, 403 F.3d 1364, 1369 (Fed. Cir. 2005); *Gemstar-TV Guide Int'l, Inc. v. ITC*, 383 F.3d 1352, 1366 (Fed. Cir. 2004). “The written description part of the specification itself does not delimit the right to exclude. That is the function and purpose of the claims.” *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 980 (Fed. Cir. 1995)(en banc)(reaffirmed by *Philips* at 1312). “The patentee is free to chose a broad term and expect to obtain the full scope of its plain and ordinary meaning unless the patentee explicitly redefines the term or disavows its full scope.” *Thorner v. Sony Computer Entertainment America, LLC*, 669 F.3d 1362, 1367 (Fed. Cir. 2012).

The prosecution history may also be relevant in construing a claim, in so far as it may provide some evidence as to how the inventor, and the United States Patent and Trademark Office (“PTO”) understood the patent, and as to whether the inventor, by disclaiming a particular interpretation of the patent, “limited the invention in the course of prosecution, making the claim scope narrower than it would otherwise be.” *Philips* at 1317 (citing *Vitronics*, 90 F.3d at 1582-83); *see also Chimie v. PPG Indus., Inc.*, 402 F.3d 1371, 1384 (Fed. Cir. 2005); *ZMI Corp. V. Cardiac Resuscitator Corp.*, 844 F.2d 1576, 1580 (Fed. Cir. 1988).

The language of the claim, the information contained in the specification, and the prosecution history available through the public notice requirements in the patent process are all considered intrinsic sources for determining the meaning of disputed terms in a patent claim. In addition, outside or extrinsic sources such as dictionaries, treatises, and expert testimony may all be considered to discern the meaning of disputed terms so long as they do not “contradict claim

meaning that is unambiguous in light of the intrinsic evidence.” *Philips* at 1324 (citing *Vitronics*, 90 F.3d at 1583-84; *Intel Corp. v. VIA Techs., Inc.*, 319 F.3d 1357, 1367 (Fed. Cir. 2003)).

ANALYSIS

The parties have agreed on definitions for nine terms, and have identified seven disputed terms within the patents that the Ecometal Defendants still believe require construction. (ECF #86). The parties agree that the remaining terms originally identified by Ecometal as disputed do not require construction.

A. Agreed Terms

The agreed constructions are as follows:

1. “*composite*”: a material made of two or more components
2. “*in situ*”: in place
3. “*precipitation*”/“*precipitate*”/“*precipitated*”/“*precipitant*”: something having a new phase different from what existed before
4. “*controlled selection of a mixing technique*”: a non-random selection of a mixing technique
5. “*solutionizing*”: a heat treatment process step
6. “*additive material*”: a material that is added
7. “*secondary metal*”: an additional metal that is added
8. “*forming*”: coming into existence
9. “*morphology*”: shape

B. Disputed Terms

The disputed terms are discussed individually below.

1. Intermetallic phase

The phrase “intermetallic phase” appears in Claims 1, 2, 14-20, 28, 29, and 37-42 of the ‘010 Patent, and claims 1, 12, 49, 73, and 74 of the ‘653 Patent. Terves contends no construction is necessary for this term, but, alternatively proposes that it be defined as “compound that has two or more metals.” Ecometal proposes the following definition: “solid phase involving two or more metallic or semi-metallic elements with an ordered structure and well-defined and fixed stoichiometry.” Terves, at the hearing and through its briefing, accepts that in the context of the relevant Patents, the intermetallic phase refers to solid particles, and that it contains magnesium or a magnesium alloy and an additive material. (ECF #36). In its claim construction brief, Terves describes how the patent specifications support defining “intermetallic phase” as “the solid particles formed by the combination of magnesium and the additive material. . . .” Therefore, the Ecometal Defendants’ inclusion of “solid” in the definition is both supported and substantively uncontested.

The remainder of Ecometal’s proposed definition, however, is unsupported by the patent language and adds limitations not included in the patent claims. Nothing in the patent or in the extrinsic evidence before the Court supports limiting “intermetallic phase” to combinations “with an ordered structure and well-defined and fixed stoichiometry.” Adopting such a definition would narrow the claim term beyond that which was included in the plain language of the patent, effectively eliminating compositions expressly addressed within the patent itself. For these reasons, the Court adopts the following definition that reflects the parties’ agreement that phase represents a solid state, and a combination of metals, without narrowing the claim by adding extraneous limitations not

contained in the language of the patent. “Intermetallic phase” is construed to mean: “solid compound that has a combination of two or more metals.”

2. Galvanically-active

The term “galvanically active” is found in the ‘010 Patent and the ‘653 Patent. Ecometal proposes defining “galvanically active” as having “a higher or lower galvanic potential compared to the magnesium or magnesium alloy.” Terves contends no construction is necessary, but alternatively suggest that it could be defined as “allowing for an electrochemical reaction.”

The Court finds that this term should be construed according to its ordinary and customary meaning without imposing any further definition which may limit or expand the claim language itself. Further explanation is not necessary to aid the court or the jury in understanding this term as it is used in the claimed invention. It appears clear from the parties’ submissions that a person of ordinary skill in the art (“POSITA”) would understand what this phrase means after reviewing the patents, including the specification language in the ‘010 and ‘653 Patents, which has been cited by Ecometal. (ECF #37, PageID # 899-900). To the extent that the request for further construction is aimed at assisting potential jurors in understanding this term, the Court finds that the language in the patent itself is not so far out of the realm of common experience that a juror could not understand its meaning. Further, neither of the proposed definitions would be likely to enhance a jurors understanding of the term. Therefore, no further construction is warranted.

3. Unalloyed additive material

The parties have agreed on the meaning of “additive material” as used in the ‘010 and the ‘653 Patents. They have defined it as “a material that is added.” Ecometal seeks to further define “unalloyed additive material” as “unreacted additive material” while Terves argues either for no

construction or for defining it as a “portion of the additive material that does not form a new compound.” In its briefing, Terves further describes this term as “the portion of the additive material that does not bond with the magnesium to form a new compound.” Ecometal admits that the definitions advanced by both parties are technically similar, and that the patent specification language, in combination with the claims language, would allow a POSITA to understand what the term means. As there is no substantive dispute as to the meaning of the term in the context of this patent, and as the patent language itself would properly inform a POSITA of the meaning of the term, the Court finds that this term should be construed according to its ordinary and customary meaning and no further definition need be provided. Further explanation is not necessary to aid the court or the jury in understanding this term as it is used in the claimed invention.

4. Sufficient quantities

This term is found in Claims 49 and 73 of the ‘653 Patent. Ecometal proposes it be defined as “present in sufficient but unspecified quantities to cause the composite to have a specified dissolution rate.” As evidenced by the use of the word “sufficient” within the definition of that same term, Ecometal’s proposed definition does not so much define the term as expand upon it. Terves argues no definition is necessary, and alternatively proposes defining it simply as “enough.” The Court finds that this term is self-explanatory and should be construed according to its ordinary and customary meaning without imposing any limitations or restrictions not specifically included in the claim language itself. A POSITA would certainly understand its meaning within the context of the Patent and further explanation is not necessary to aid the court or the jury in understanding this term as it is used in the claimed invention

5. Improve tensile strength, ductility, or combination thereof

This term is found in Claims 10, 11, 24, and 25 of the '010 Patent. Ecometal suggests that the entire phrase be defined as “any increase or decrease in properties that would have been desirable.” Ecometal obtained this proposed definition not from the language or context of the Patents at issue in this case but from an Examiner’s opinion of what the word “improve” should mean in an allegedly “related” Patent. This definition is over broad and indefinite. It does not limit the properties at issue to tensile strength and ductility, and does not give the reader any indication as to whether an increase or decrease is desirable for each relevant property in the context of the '010 Patent.

Terves argues that no construction is necessary for this term. Alternatively, it would have the Court define this term as “to provide a greater tensile strength (resistance of a material to break under tension), greater ductility (ability to undergo deformation before rupture), or both.” Ecometal agreed at the hearing to Terves’ proposed definitions of tensile strength (“resistance of a material to break under tension”) and ductility (“ability to undergo deformation before rupture”), leaving only the word “improve” in dispute. Where Terves would define improve as “to provide greater,” tensile strength and/or ductility, Ecometal’s proposal would define “improve” as any desirable increase or decrease in those properties. This would not make sense as there is no basis upon which to believe, in the context of the Patent, that a POSITA could read that Patent in such a way that they would understand a decrease in those properties would ever be desirable. While the Court believes that a POSITA would need no construction of this phrase, Terves’ proposed instruction could assist a jury in understanding the terms “improve,” “tensile strength,” and “ductility,” within the context of the Patent at issue. Therefore, the Court adopts Terves’ proposed construction of these terms and

defines “improve tensile strength, ductility, or combinations thereof” as “provide a greater tensile strength (resistance of a material to break under tension), greater ductility (ability to undergo deformation before rupture), or combinations thereof.”

6. Melting point/ Melting temperature

The term “melting point” or “melting point temperature” is used in the ‘010 Patent to describe both the temperature of “magnesium or magnesium alloy” and of “additive material.” The parties agree that the term “melting point” is generally known to be the temperature at which a solid material melts or reaches its liquid state. Therefore, using “melting point” to describe the temperature of a pure metal would need no construction, as it is fully liquified at the same temperature at which it begins to liquify. However, because the term is used within the ‘010 Patent not only in connection with pure substances but with alloys, or combined , the question becomes more complicated. An alloy includes a mix of elements, which may each have different melting points. Therefore, a solid alloy may begin to liquify at one temperature, but not fully liquify until it reaches a higher temperature. The temperature at which an alloy begins to melt is called the solidus temperature, while the temperature at which it is fully liquified is called the liquidus temperature. In between these two temperatures, in the solidus-liquidus range, the material includes both solid and liquid phases of the alloy simultaneously. The parties disagree on whether the term melting point temperature refers to the solidus or liquidus temperature when the Patent refers to the melting point temperature of an alloy.

Ecometal’s admits that no construction is necessary when the term “melting point” is used to describe the temperature of magnesium with zero additive. However, it seeks to define the melting point of an alloy as the liquidus temperature. It further attempts to define the melting temperature of

an additive using both terms, advocating for the construction: “melting point temperature or liquidus temperature” of the additive material. Terves originally contended that the melting point temperature should simply be defined as “the temperature at which liquid is formed.” At the hearing, they honed that definition slightly acknowledging the solidus/liquidus discrepancy in the liquification of alloys, and clarifying that they believe the melting temperature is that at which liquid is first formed. This would be the equivalent of the solidus temperature.

The ASM handbook defines that melting point temperatures that at which “a pure metal, compound, or eutectic changes from solid to liquid; [sic] the temperature at which the liquid and the solid are in equilibrium.” A state of equilibrium implies a balance between two states, not necessarily a completed transition from one to the other. This better supports Terves’ definition of melting point which describes the temperature at which that transition begins to occur, not the temperature at which it has concluded. In addition, Claim 1 of the ‘653 Patent, when comparing the melting point temperature of additive material with that of the magnesium composite (which is made up of magnesium or magnesium alloy), refers to the solidus temperature of the magnesium [composite]. This again supports Terves’ interpretation of melting point as the temperature at which the material begins to melt (the solidus temperature). In addition, the common usage of the phrase melting point refers to that point in time when a solid begins to melt, not when it has completely liquified. Therefore, absent some other indicator within the Patent language, the melting point temperature is better defined at the temperature at which the referenced solid begins to melt, than the temperature at which it is fully liquified. The phrase “melting point temperature” is thus construed to mean “the temperature at which liquid is first formed.”

7. Portion of said additive materials forming solid particles/a portion of said additive material remaining unalloyed additive material

This term is found in Claims 20, 28, 29 and 37-42 of the '010 Patent, and Claims 12 and 71 of the '653 Patent. Ecometal claims that this language fails to inform a POSITA of the scope of the invention in the above listed claims and that it is, therefore, indefinite. Terves argues that the term needs no construction and that it adequately describes the claimed limitations. Several segments of this phrase have already been defined in the constructions set forth above. The parties previously agreed to define "additive material" as "a material that is added." Further, the Court found that "unalloyed additive material" needs no further construction, as set forth above. Similarly, none of the remaining terms in this phrase require construction. The language used is straight forward and its meaning is apparent on its face.

Ecometal's argument that this language renders the claims indefinite is not well taken at this juncture. Ecometal has the burden of proving indefiniteness by clear and convincing evidence. *See BASF Corp. v. Johnson Matthey Inc.*, 875 F.3d 1360, 1365 (Fed. Cir. 2017). That burden has not been met. A patent claims is indefinite only if when "read in the light of the specification delineating the patent, and the prosecution history, [the claim] fail[s] to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2124, 189 L.Ed.2d 37 (2014). Arguing that a claim is over broad is not a basis upon which to determine indefiniteness. *See, SmithKline Beecham Corp. v. Apotex Corp.*, 403 F.3d 1331, 1341 (Fed. Cir. 2005). Ecometal submits only extrinsic evidence in the form of own expert's argument in support of its position that these claims are indefinite because a POSITA could not determine what portion of additive material forms solid particles versus what portion remains unalloyed in the

claimed invention. There is no evidence to suggest, however, that the invention requires any particular ratio of alloyed and unalloyed materials is required by the invention so long as some portion of the additive material reacts with magnesium to form a solid and some remains unalloyed. Ecometal's expert admitted during deposition that a POSITA would be able to understand that the scope of the invention is defined not by the existence of a specific portion of additive material meeting the remaining limitation conditions, but of any portion meeting those conditions. (Medlin Depo., ECF #36-5, 81:19-82:13). Terves' expert also opined that a POSITA would understand this from the claim language, especially as supported by the specification language from the '010 and '653 Patents. (Swanger Report, ECF #36-4, at 12-13). There is no evidence, at this point, to suggest that amount of each portion is relevant to whether a competing product meets this limitation of the claimed invention. Further, even Ecometal believes the limitation is overly broad and the portion size should be limited to a specific amount or range of amounts, that would not support a finding of indefiniteness. "Breadth is not indefiniteness." *SmithKline Beecham Corp. v. Apotex Corp.*, 403 F.3d 1331, 1341 (Fed. Cir. 2005); *see also, BASF Corp. V. Johnson Matthey Inc.*, 875 F.3d 1360, 1365 (Fed. Cir. 2017). For these reasons, Ecometal has not satisfied its burden of showing that this claim term is indefinite by clear and convincing evidence, and the term in question needs no further construction.

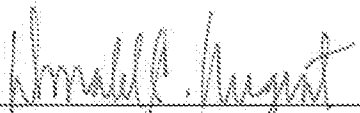
CONCLUSION

For the reasons set forth above, the Court adopts the following construction of the disputed terms in the relevant patents:

1. "intermetallic phase": solid compound that has a combination of two or more metals

2. "improve tensile strength, ductility, or combinations thereof": provide a greater tensile strength (resistance of a material to break under tension), greater ductility (ability to undergo deformation before rupture), or combinations thereof
3. "melting point/melting point temperature": the temperature at which liquid is first formed

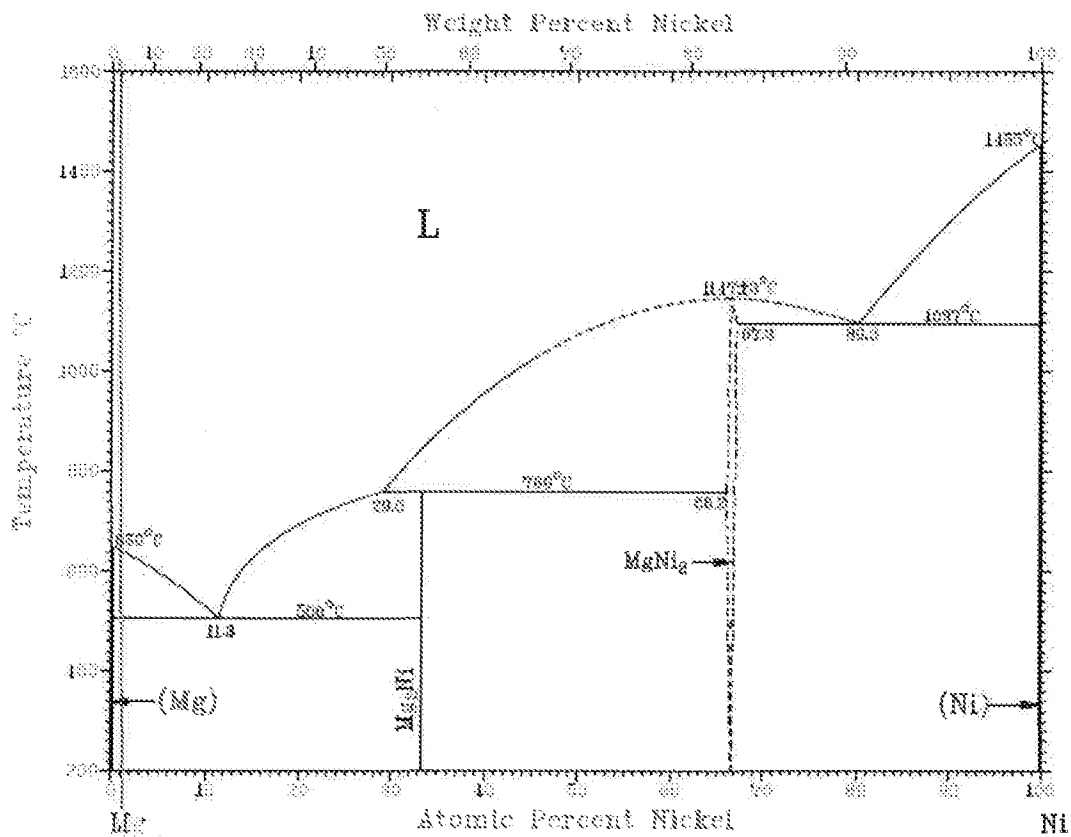
The remaining disputed terms require no further construction and shall be given their ordinary and customary meanings. IT IS SO ORDERED.



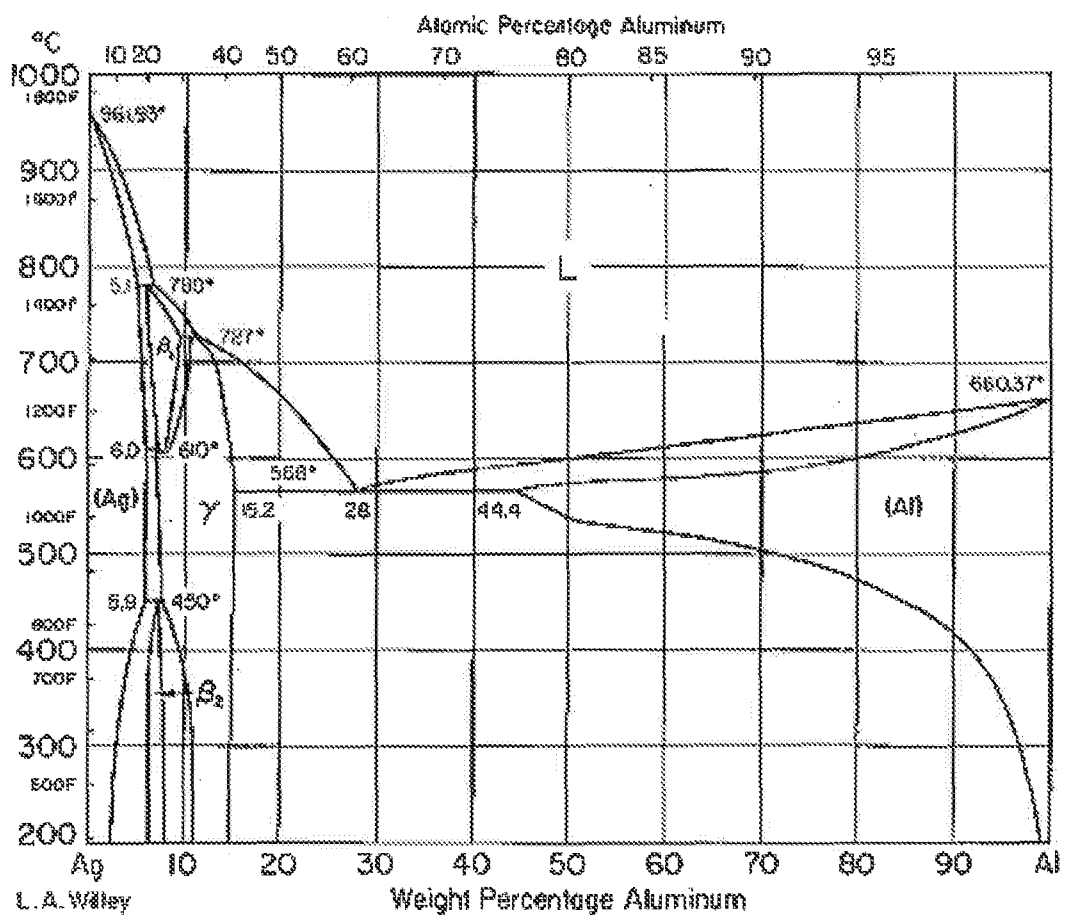
DONALD C. NUGENT
UNITED STATES DISTRICT JUDGE

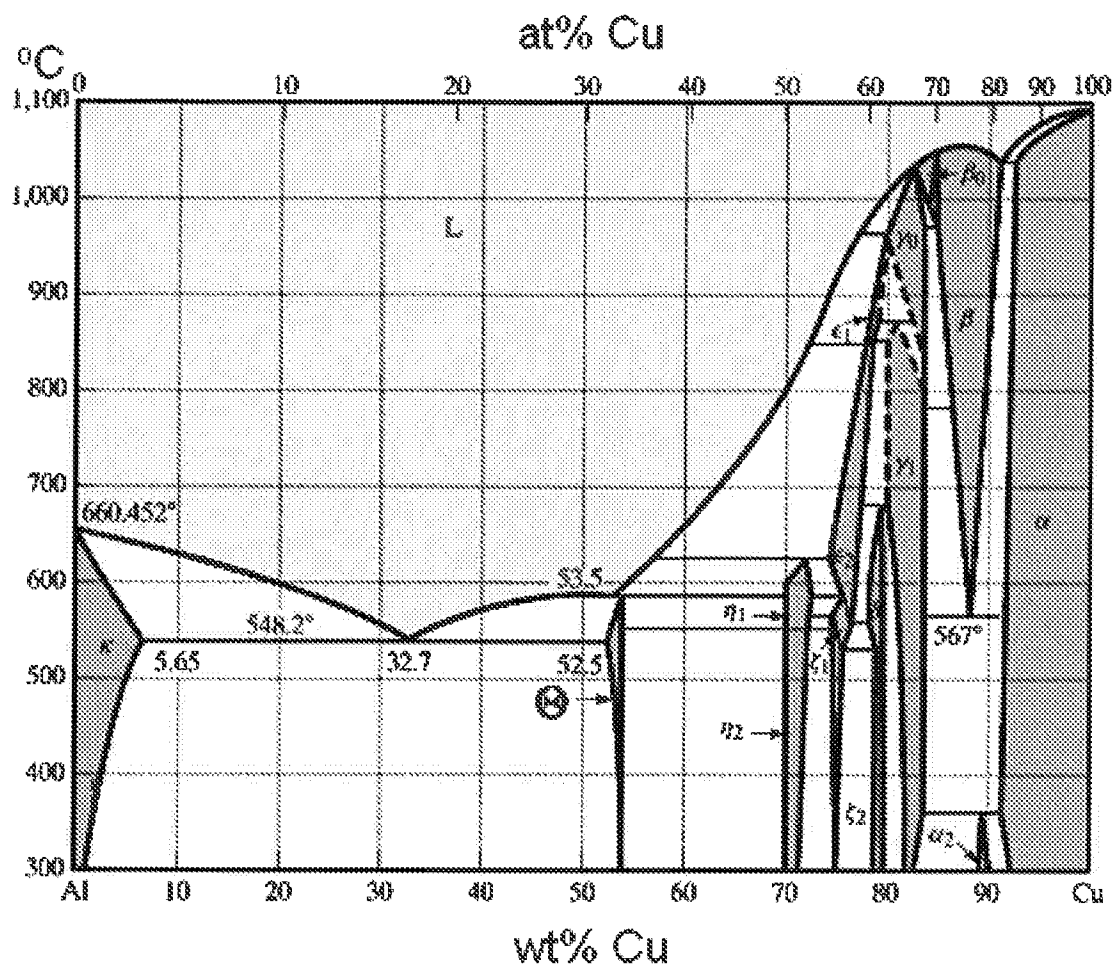
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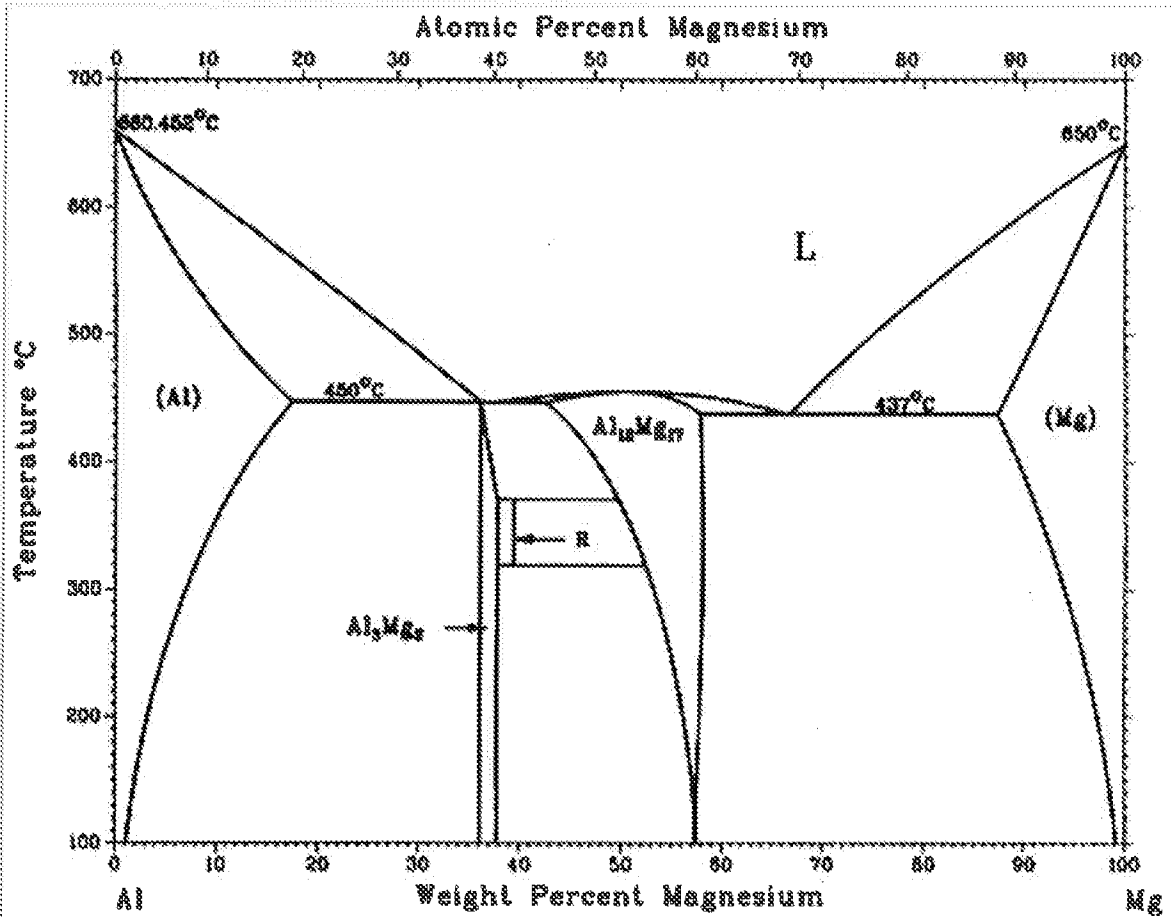
Exhibit C



Ag-Al Silver-Aluminum







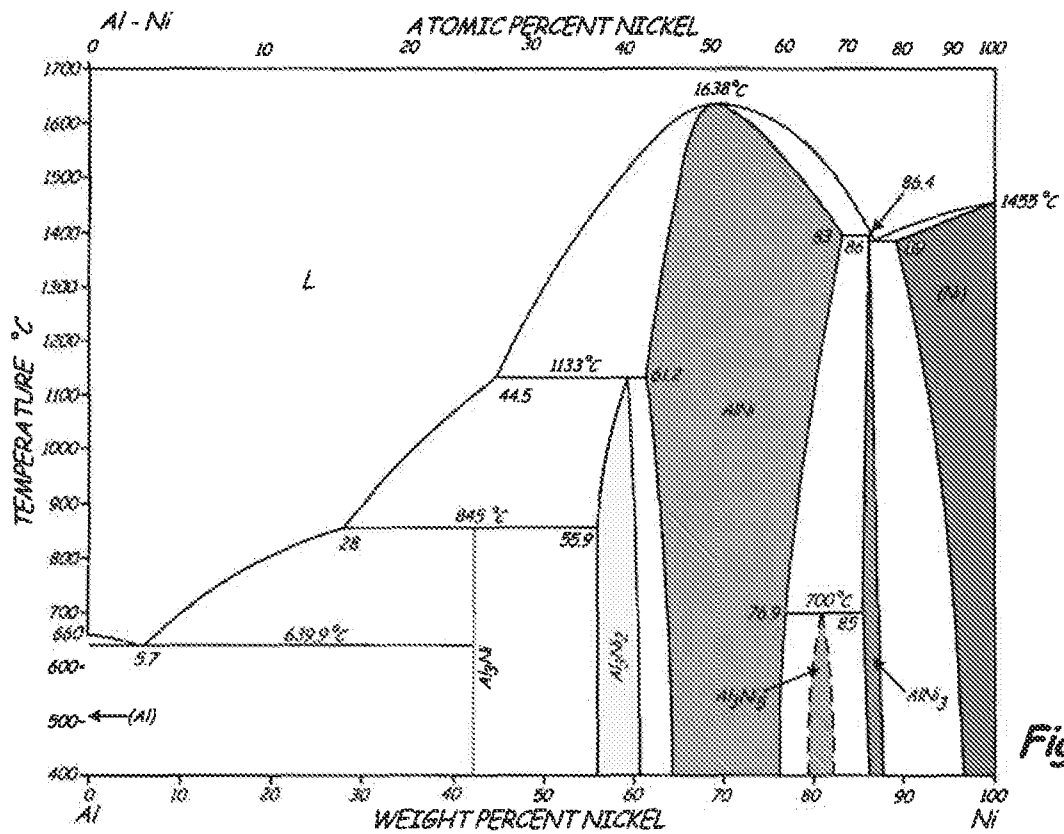


Fig. 1