UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

POSCO,

Petitioner,

v.

ARCELORMITTAL,

Patent Owner.

Case No. IPR2019-01275
Patent No. 9,708,683

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 9,708,683 CHALLENGING CLAIMS 1-11

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PETITIONER'S EXHIBIT LIST

Exhibit	Description
Ex. 1001	U.S. Patent No. 9,708,683 to Drillet et al. ("the '683 patent")
Ex. 1002	Patent Prosecution History of the '683 patent
Ex. 1003	Declaration of Dr. Michael Miles
Ex. 1004	Cornette et al., "High Strength Steels For Automotive Safety Parts," SAE Technical Paper 2001-01-0078, 2001 ("Cornette," "Cornette-1," or "Paper Series Form")
Ex. 1005	Mahesh C. Somani, et al., "Dimensional Changes and Microstructural Evolution in a B-bearing Steel in the Simulated Forming and Quenching Process," ISIJ International, 2001, Volume 41, Issue 4, Pages 361-367 ("Somani")
Ex. 1006	WO Application Pub. No. 2004/106573 to Nishibata et al. ("Nishibata")
Ex. 1007	Certified Translation of Nishibata
Ex. 1008	U.S. Patent No. 6,296,805 to Laurent et al. ("Laurent")
Ex. 1009	French Application Pub. No. 2,833,504 to Laurent et al. ("FR Laurent")
Ex. 1010	Certified Translation of FR Laurent
Ex. 1011	European Application Pub. No. 1,013,785 to Laurent et al. ("EP Laurent")
Ex. 1012	Certified Translation of EP Laurent
Ex. 1013	Copy of Cornette-1 from University of Washington's Engineering Library

Ex. 1014	Copy of Cornette et al., "High Strength Steels For Automotive Safety Parts," New Sheet Steel Products and Sheet Metal Stamping-SP-1614, SAE 2001 Transactions Journal of Materials & Manufacturing-V110-5 ("Cornette-2" or "Transactions Form") from University of Washington's Engineering Library
Ex. 1015	Declaration #1 of Mel Desart, Head of Engineering Library at the University of Washington
Ex. 1016	Declaration #2 of Mel Desart, Head of Engineering Library at the University of Washington
Ex. 1017	Copy of Somani from University of Michigan's Art, Architecture, and Engineering Library
Ex. 1018	Declaration of Martin Knott, Head of Metadata within the University of Michigan Library's Technical Services Department
Ex. 1019	WO Application Pub. No. 2008/053273 to Drillet et al. ("WO Drillet")
Ex. 1020	SAE's Publication History for Cornette
Ex. 1021	Fekete, J., Stibich, A., and Shi, M., "A Comparison of the Response of HSLA and Dual Phase Sheet Steel in Dynamic Crush," SAE Technical Paper 2001-01-3101, 2001
Ex. 1022	Robert R. Mayer, "Theoretical Effects of Hydroforming on Crashworthiness of Straight Sections," ASME International Mechanical Engineering Congress and Exposition, Applied Mechanics (2004):591-603

Ex. 1023	Japanese Application Pub. No. JP/2006/051543 to Abe et al. ("Abe")
Ex. 1024	Machine Translation of Abe
Ex. 1025	ISIJ's Publication History for Somani
Ex. 1026	Webster's New Twentieth Century Dictionary (2nd ed. 1964)
Ex. 1027	Random House Webster's Unabridged Dictionary (2nd ed. 1998)
Ex. 1028	ASM Materials Engineering Dictionary
Ex. 1029	Dictionary of Materials and Manufacturing
Ex. 1030	McGraw-Hill Dictionary
Ex. 1031	Certified Translation of "alliation" and "alliage."
Ex. 1032	U.S. Patent Pub. No. 2004/0238080 to Vanderputte et al. ("Vanderputte")
Ex. 1033	Reserved
Ex. 1034	Reserved
Ex. 1035	Ahindra Ghosh, "Secondary Steelmaking, Principles and Applications" (2001)
Ex. 1036	X. Bano, JP. Laurent, "Heat treated boron steels in the automotive industry," 39TH Mechanical Working and Steel Processing Conference Proceedings, Volume XXXV, Indianapolis, IN 1997, p 673-77 ("Bano")
Ex. 1037	Åkerström, P. et al., "Material parameter estimation for boron steel from simultaneous cooling and compression experiments," Modelling and Simulation in Materials Science and Engineering. 2005, Vol.13, No.8, p.1291.

Ex. 1038	ASTM Dictionary of Engineering Science & Technology (10th ed. 2005).
Ex. 1039	Chambers Dictionary of Science and Technology (1999)
Ex. 1040	Webster's Third New International Dictionary (2002)
Ex. 1041	Engels, H. et al., "Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels." – p. 135-50 ("Engels"), *published in* Liewald, M. (Ed.). "New developments in sheet metal forming": Frankfurt a.M.: MAT-INFO, Werkstoff-Informationsges (2006)
Ex. 1042	Declaration of Marcel Thoms, Deputy Head of Media Services and Head of Acquisition and Cataloguing at the University of Stuttgart's University Library
Ex. 1043	WO Application Pub. No. 2002/103073 to Suehiro et al. ("Suehiro")
Ex. 1044	Certified Translation of "Stahl"

I. INTRODUCTION

Petitioner requests *Inter Partes* Review ("IPR") of claims 1-11 (the "Challenged Claims") of U.S. Patent No. 9,708,683 ('683 patent). Ex. 1001. The '683 patent is assigned to ARCELORMITTAL ("Patent Owner") per the assignments at reel/frame: 048673/0772.

The Board should institute an IPR and cancel the Challenged Claims.

II. MANDATORY NOTICES

A. Real Party-in-Interest (37 C.F.R. § 42.8(b)(1))

The real party-in-interest is POSCO ("Petitioner").

B. Related Matters (37 C.F.R. § 42.8(b)(2))

As of the filing of this petition, no judicial or administrative matters are known to Petitioner that would affect, or be affected by, a decision in an IPR of the '683 patent. It is our understanding that oppositions are pending in the European Patent Office for the European counterpart of the '683 patent.

C. Counsel (37 C.F.R. § 42.8(b)(3)) and Service Information (37 C.F.R. § 42.8(b)(3)-(4))

Petitioner designates Dion Bregman (Reg. No. 45,645) as lead counsel for this matter, and designates Michael Miller (Reg. No. 75,590), Hosang Lee (Reg. No. 69,333), and Daniel Bucca (Reg. No. 42,368) as back-up counsel.

Postal mailings and hand-deliveries for lead and back-up counsel should be addressed to: Morgan, Lewis & Bockius LLP, 1400 Page Mill Road, Palo Alto, CA

94304 (Telephone: 650.843.4000; Fax: 650.843.4001).

Pursuant to 37 C.F.R. § 42.8(b)(4), Petitioner consents to e-mail service at: POSCO-IPR@morganlewis.com.

For compliance with 37 C.F.R. § 42.10(b), a Power of Attorney is also filed concurrently herewith.

III. CERTIFICATION AND FEES

Petitioner certifies that the ’683 patent is available for IPR and that Petitioner is not barred or estopped from requesting this IPR on the grounds identified herein.

Any additional fees for this IPR may be charged to Deposit Account No. 50-0310 (Order No. 123301-0001).

IV. IDENTIFICATION OF CLAIMS AND GROUNDS

The application for the ’683 patent (U.S. Patent Application No. 13/621,015), was filed on September 15, 2012. The ’683 patent identifies itself as a divisional application of U.S. patent application No. 12/447,777 (now U.S. Patent No. 8,307,680) filed March 18, 2011, which is a National Stage Application of PCT/IB2006/004019 filed October 30, 2006. Ex. 1019.

Because the filing date of the ’683 patent (and all applications to which it claims priority) is before the effective date of the America Invents Act (AIA), *i.e.*, March 16, 2013, the pre-AIA statutes apply.

For purposes of this IPR, Petitioner treats October 30, 2006, the filing date of the cited PCT/IB2006/004019 application, as the "Alleged Priority Date" for all challenged claims.

Petitioner relies on the following references:

A. Non-Patent Literature

Whether a reference constitutes a prior art printed publication under § 102(b) is a legal conclusion based on underlying factual determinations. *GoPro, Inc. v. Contour IP Holding LLC*, 898 F.3d 1170, 1173-74 (Fed. Cir. 2018) (opinion modified on other grounds). The Federal Circuit has "interpreted § 102 broadly, finding that even relatively obscure documents qualify as prior art so long as the relevant public has a means of accessing them." *Id.* at 1174.

1. Cornette is a Printed Publication

Cornette is a printed publication published by the Society of Automotive Engineers (SAE) in the SAE Technical Paper Series (**Cornette**-1, Paper Series Form, Ex. 1004) and in the SAE 2001 Transactions Journal of Materials & Manufacturing (**Cornette**-2, Transactions Form, Ex. 1014). *See* Ex. 1004 at 3 ("Copyright © 2001 Society of Automotive Engineers"); Ex. 1014 at 37 (same); *see also LG Elec., Inc. v. Advanced Micro Devices, Inc.*, IPR2015-00329, Paper 13 at 12 (PTAB July 10, 2015) (copyright date is *prima facie* evidence of publication).

Physical copies of Cornette-1 and Cornette-2 were received and maintained

by the **University of Washington**. In particular, the Engineering Library at the University of Washington received a copy of Cornette-1 (in the Paper Series Form) by March 13, 2001. *See* Ex. 1013 at 0001 (library stamp: "University of Washington, MAR 13 2001, LIBRARIES, ENGINEERING"). The Head of the Engineering Library at the University of Washington, Mr. Melvin DeSart, confirmed that "[o]nce a paper is stamped, it is routed to the Library for shelving and is normally placed in the Library's stacks within a few weeks of its receipt." Ex. 1015 at 2. In other words, Cornette-1 was **publicly accessible** at least as early as April 3, 2001 (*i.e.*, a few weeks from March 13, 2001).

The University of Washington also received a copy of Cornette-2 (in the Transactions Form) by November 17, 2002. *See* Ex. 1014 at 0001 (library stamp: "University of Washington Libraries NOV 10 RECD" and "Engineering New Book Shelf NOV 17 2002"); Ex. 1016 at 2 (confirming "[o]nce a paper is stamped, it is routed to the Library for shelving and is normally placed in the Library's stacks within a few weeks of its receipt").

Additionally, SAE's website provides publication dates for the **multiple forms of Cornette** published by SAE, including **Cornette-1** and **Cornette-2**. *See* Ex. 1020 at 0001-0002 (providing that Cornette-1 in the Paper Series Form published March 5, 2001; Cornette-2 in the Transactions Form published September 15, 2002; and **Cornette**-3 in New Sheet Steel Products and Sheet Metal

Stamping published March 5, 2001); *see also Coriant (USA) Inc. et al v. Oyster Optics, LLC*, IPR2018-00258, Paper 13 at 11 (PTAB June 6, 2018) (holding that "[f]or established publishers, demonstrating **a date of publication** is alone sufficient for showing accessibility to the public").[1] Notably, the publication dates for Cornette-1 and Cornette-2 provided by SAE are consistent with the date stamps of Exhibits 1013 and 1014 authenticated by Mr. DeSart.

The evidence above confirms that Cornette was disseminated or otherwise made available to the interested public before the Alleged Priority Date. *See In re Hall*, 781 F.2d 897, 899-900 (Fed. Cir. 1986) (single dissertation shelved and indexed in library was a printed publication); *see Palo Alto Networks, Inc. and Symantec Corp. v. Finjan, Inc.*, IPR2015-01979, Paper 62 at 20-29 (PTAB March 15, 2017) (crediting testimony of Mr. DeSart that a reference was publicly available).

There is also substantial evidence corroborating that Cornett was accessible to the interested public before the Alleged Priority Date. In particular, Cornette was cited in patents and several other documents before the Alleged Priority Date. *See* Ex. 1043 at 2:23-27 (patent application published December 27, 2002 and

[1] Annotations, colorization, and emphasis added throughout unless otherwise noted.

citing Cornette); Ex. 1021 at 3, 8 (published October 16, 2001 and citing Cornette); Ex. 1022 at 2, 7 (copyright of 2004 and citing Cornette); Ex. 1023 and 1024 at ¶ 0003 (patent application published February 23, 2006 and citing Cornette).

Thus, Cornette is **§ 102(b) prior art** because it was publicly accessible more than a year before the Alleged Priority Date.

2. Somani is a Printed Publication

Somani is a printed publication, bearing a **copyright date of 2001**, published by the Iron and Steel Institute of Japan (ISIJ). *See* Ex. 1005 at 1 ("© 2001 ISIJ); Ex. 1017 at 0002 ("© COPYRIGHT 2001 BY THE IRON AND STEEL INSTITUTE OF JAPAN"); *see also Advanced Micro Devices*, IPR2015-00329, Paper 13 at 12 (copyright date is *prima facie* evidence of publication).

A physical copy of Somani was received and maintained by the **University of Michigan**. In particular, the Art, Architecture, and Engineering Library at the University of Michigan received a copy of Somani by June 1, 2001. *See* Ex. 1017 at 1 (library stamp: "University of Michigan, JUN 01 2001"). The University Library's Head of Metadata, Mr. Martin Knott, confirmed "when a journal volume … was or is received by the University Library, it would be checked in, [and] stamped with the date of receipt … and made available to library patrons or visitors (*i.e.*, the general public) … [within] at most 2 to 3 weeks." Ex. 1018 at 2-3. In other words, Somani was publicly accessible at least as early as June 22,

2001 (*i.e.*, three weeks from June 1, 2001).

There is also substantial evidence corroborating that Somani was accessible to the interested public before the Alleged Priority Date. For example, ISIJ's website also provides that Somani was published on April 15, 2001. *See* Ex. 1025 at 0001 ("Published: April 15, 2001"); *see Coriant*, IPR2018-00258, Paper 13 at 11 (holding that "[f]or established publishers, demonstrating **a date of publication** is alone sufficient for showing accessibility to the public"). Somani is also cited in a document that was accessible by the interested public before the Alleged Priority Date. *See* Ex. 1037 at 1291, 1307 (published November 4, 2005 and citing Somani); *see also* Ex. 1025 at 0002 (showing that Somani was cited by Ex. 1037 in 2005).

This evidence confirms that Somani was disseminated or otherwise made available to the interested public before the Alleged Priority Date.

Thus, Somani is **§ 102(b) prior art** because it was publicly accessible more than a year before the Alleged Priority Date.

3. Engels is a Printed Publication

Engels is an article published in the "New Developments in Sheet Metal Forming," which bears a copyright date of 2006. *See*, *supra*, Petitioner's Exhibit List; Ex. 1041 at 0002.

A physical copy of Engels was received and maintained by the **University**

of Stuttgart. Ex. 1042. According to Mr. Marcel Thoms, the Deputy Head of Media Services and Head of Acquisition and Cataloguing at the University of Stuttgart's University Library, Engels was listed in the Library's inventory on **June 9, 2006** and registered in the Library's loan management system on **June 13, 2006**. Ex. 1042 at 2. Mr. Thoms further states that, in 2006, "the usual process was that a newly acquired book was first listed in the inventory, then given to the cataloguing team, then equipped (i.e. stamp, bar code, shelf mark sign, etc.) and afterwards registered in the loan management system. **After registration, it usually took a few days for the book to be placed in the shelves**." Ex. 1042 at 2. In other words, Engels was publicly accessible in physical form at least as early as June 16, 2006 (*i.e.*, a few days after June 13, 2006). *See id*. ("it is very likely that the book was available to the public within a few days after June 13th, 2006").

Mr. Thoms also states that the "title was listed in the South-West-German Union Catalogue SWB[] also on June 9th, 2006[]. When a title is listed in the union catalogue, **it is immediately visible online**. From the moment the book is registered in the loan management system, **reservations and orders can be placed**." *Id*. In other words, Engels was publicly accessible in electronic form at least as early as June 9, 2006. *Cf. In re Hall*, 781 F.2d at 899-900 (holding that a single dissertation shelved and indexed at Freiburg University library in Germany qualified as a printed publication).

Thus, Engels is **§ 102(a) prior art** because it was publicly accessible before the Alleged Priority Date.

B. Patents and Patent Applications

Nishibata (Ex. 1006) WO 2004/106573 published on December 9, 2004. Nishibata is prior art under **§ 102(b)** because it was published more than a year before the Alleged Priority Date. Ex. 1007 is a certified English translation of the Japanese language original, Ex. 1006.

Laurent (Ex. 1008) U.S. Patent No. 6,296,805 issued on October 2, 2001. Laurent is prior art under **§ 102(b)** because it issued more than a year before the Alleged Priority Date.

FR Laurent (Ex. 1009) FR 2,833,504 published on June 20, 2003. FR Laurent is prior art under **§ 102(b)** because it was published more than a year before the Alleged Priority Date. Ex. 1010 is a certified English translation of the French language original, Ex. 1009.

EP Laurent (Ex. 1011) EP 1,013,785 published on June 28, 2000. EP Laurent is prior art under **§ 102(b)** because it was published more than a year before the Alleged Priority Date. Ex. 1012 is a certified English translation of the French language original, Ex. 1011.

Petitioner submits that the Challenged Claims are unpatentable based on the following grounds:

Ground	**Statutory Basis and Art Cited**	**Claims Challenged**
1	§ 102 – Anticipated by Cornette	1-2
2	§ 103 – Obvious over Cornette	8, 11
3	§ 103 – Obvious over Cornette in view of Laurent	3-4, 6-7, 10
4	§ 103 – Obvious over Cornette in view of Laurent, EP Laurent, and FR Laurent	11
5	§ 103 – Obvious over Cornette in view of Nishibata	5
6	§ 103 – Obvious over Cornette in view of Somani	9
7	§ 103 – Obvious over Cornette in view of Engels	11

V. BACKGROUND

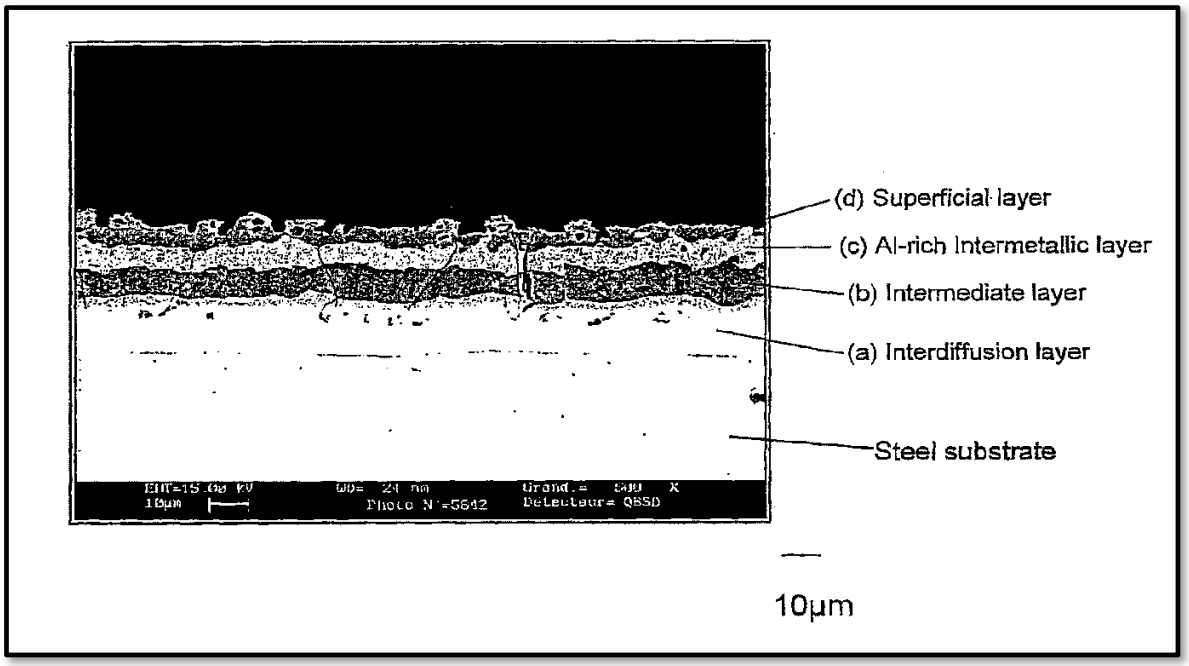
A. Overview of the ’683 Patent

The ’683 patent is directed toward a coated steel product prepared from a base steel with an aluminum pre-coating. Ex. 1001 at claim 1. These types of coated steel products can be obtained by heat treating and stamping a pre-coated steel, whereby heating the pre-coated steel causes an alloying reaction between the aluminum pre-coating and the base steel. *Id*. at 6:14-22.

The ’683 patent admits that hot stamping pre-coated steels was a known process, especially to those in the automotive industry. *Id*. at 1:40-42. The ’683 patent further admits that a prior art patent to the same assignee, U.S. Pat. No. 6,296,805 to Laurent et al. (Ex. 1008, “the ’805 patent”), discloses the main fabrication steps for hot stamping pre-coated steels, including “Pre-coating of a

steel sheet[], by hot dipping," "Heating the blanks in order to obtain alloying of the steel substrate with the pre-coating," and "Hot forming followed by rapid cooling of the part in order to obtain predominantly martensitic structures." *Id*. at 1:42-51.

The '683 patent attempts to differentiate itself from the '805 patent by alleging that three needs remain for coated steels, namely: (i) "a need for coated steels which may be conveniently used to prepare shaped parts by a stamping process," (ii) "a need for coated steels which may be used to prepare shaped parts by a stamping **process** which are suitable for welding," and (iii) "a need for **processes** for preparing such coated steels and stamped parts." *Id*. at 2:28-34. The '683 patent, however, neither describes nor claims a novel or non-obvious **process** for preparing or stamping pre-coated steels. Instead, the claims of the '683 patent are directed toward a ***finished stamped product***, and, in particular, a **coating** of the finished stamped product resulting from an alloying reaction between the aluminum pre-coating and the base steel. *See id*. at claim 1.



<u>'683 patent, Ex. 1001, Figure 1</u>

Figure 1 of the '683 patent, above, shows an example of the claimed coating, which is composed of a succession of coating layers starting at the steel substrate. *Id*. at 6:22-30.

As explained below, these features were well known in the art years before the Alleged Priority Date.

B. <u>Prosecution History</u>

U.S. Patent Application No. 13/621,015 ('015 application), which resulted in the '683 patent, was filed on September 15, 2012. Ex. 1002 at 70. The Examiner rejected the claims as independently anticipated by two prior art references, Laurent (Ex. 1008) and Takagi (U.S. Patent Pub. No. 2004/0009366). *Id*. at 134-40, 199-206. After failing to convince the Examiner twice that the pending claims

were patentable, applicant appealed. *Id.* at 218.

The Board ultimately reversed the Examiner, stating that he had "not explained why heating would cause a 20 micrometer aluminum coating [of Laurent] to ultimately be greater than 30 micrometers thick (**a 50% expansion**)," and, consequently, the Examiner had not shown by a preponderance of the evidence "that Laurent's process is identical or substantially identical to the Specification's process that results in a coating having a thickness as recited in claim 24." *Id*. at 441.

A Notice of Allowance issued on December 12, 2016. In the Reasons for Allowance, the Examiner cautioned that the "[s]pecification as originally filed **does not explicitly set forth the particular parameters necessary in order to produce the claimed invention of a coating having a thickness greater than 30 micrometers**," and, thus, he was "not in a position to determine which thicknesses for the pre-coating would result in the claimed invention's coating thickness." *Id*. at 448-49. The Examiner noted that the "**thickness of the pre-coating** was **the <u>only</u> difference** in the process for producing the claimed product that was discussed by the Board in its decision." *Id*. at 448.

Patent Owner's own reference (**FR Laurent**), however, provides explicit disclosure of why heating causes an aluminum pre-coating to expand by 50%. *See* Ex. 1010 at 5 ("By interdiffusion, the alloying **leads to an *increase* of the**

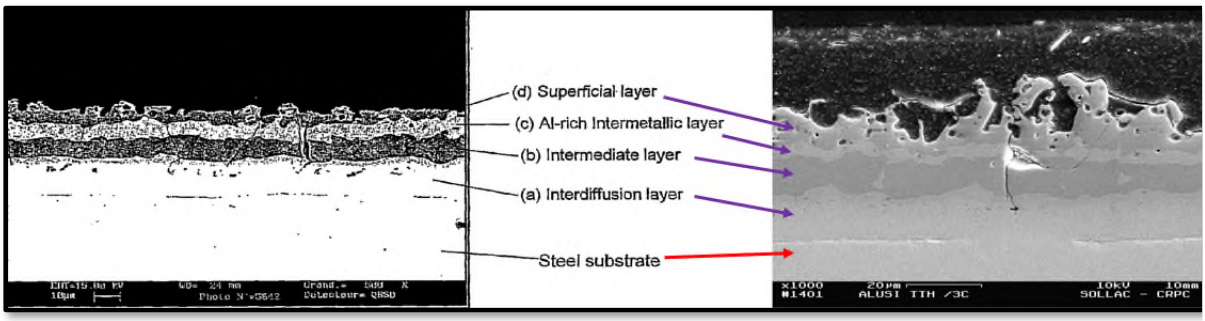
thickness of the layer which, for the treatment specified above, **corresponds to a <u>50% *increase*</u>**"). Patent Owner **failed to bring** FR Laurent to either the Examiner's or the Board's attention.

C. <u>Cited References</u>

1. Cornette

The Office has not previously considered Cornette.

Cornette discloses a coated steel product prepared from a base steel with an aluminum alloy pre-coating. *See* Ex. 1004 at Abstract, 9-11. Like the '683 patent, Cornette's "pre-coated boron steel" enables fabrication of "complex [automobile] parts[] by hot stamping." *Id*. at 11. Furthermore, Cornette provides explicit disclosure of the features that led to the '683 patent receiving an allowance, namely a "coating [that] has a thickness greater than 30 micrometers." *See id*. at 9 (disclosing that "**Fe-Al-Si layer is typically about *40 μm* at the steel surface**").



<u>'683 Patent, Ex. 1001, Fig. 1</u> **<u>Cornette, Ex. 1004, Fig. 22</u>**

As shown in Figure 22 (above, right), Cornette's Fe-Al-Si layer is composed of a succession of coating layers starting at the steel substrate. And like the '683

patent, Cornette discloses that "[h]eating the pre-coated boron steel (generally 900°C, 5 minutes) creates an alloying reaction between substrate (iron) and the coating (aluminum - silicon) which leads to a hard multiphase alloy layer," as shown in Figure 22 (above, right). *Id*. at 9-10. Cornette explains that the steel substrate is pre-coated using a "hot dipped process" whereby an average thickness of the pre-coating is "25 μm." *Id*. Cornette's 25 μm thick pre-coating falls squarely within the 20-33 μm pre-coating thickness range disclosed in Example 2 of the '683 patent, which the '683 patent claims resulted in a **40 μm** final coating. Ex. 1001 at 12:5-15, 12:45-60.

Petitioner notes that Cornette bears some resemblance to a reference cited (but not applied) during prosecution of the '683 patent. *See* Ex. 1002 at 61 (Applicant citing document authored by "L. Vaissiere et al." in information disclosure statement). The cited reference (Vaissiere) and Cornette have common figures, likely because the references have a common contributor: Jean-Pierre Laurent. With that said, and unlike Vaissiere, Cornette explicitly recites a thickness of the coating **after** heat treatment while Vaissiere lacks such explicit disclosure. *See* Ex. 1004 at 9 (stating that "**Fe-Al-Si layer** is typically about 40 μm **at the steel surface**"). As such, Cornette and Vaissiere have material differences, and, therefore, Cornette warrants consideration. *See Becton Dickinson & Co v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8, 17-18 (PTAB Dec. 15,

2017) (informative) (identifying several nonexclusive factors for evaluating 35 U.S.C. § 325(d)). Cornette was not cited during prosecution (and while Vaissiere was cited, it was not applied or even mentioned by the Examiner). Because of this, *Becton* factors favor consideration of Cornette.

2. Somani

The Office has not previously considered Somani.

Somani is directed toward forming and quenching processes for boron steels. Ex. 1005 at Abstract. Particularly, Somani provides a detailed account of how "hot compression and simultaneous or subsequent fast cooling" changes a microstructure of a boron steel. *Id*. at 362. Somani found that plastic deformation (*e.g.*, caused by hot stamping) of a boron steel enhances ferrite formation in the boron steel, which results in the boron steel having decreased mechanical properties (*e.g.*, strength) relative to a boron steel with a completely martensitic structure. *Id*. at Abstract. Therefore, according to Somani, "several variables, such as the temperature at the moment of deformation, the amount of plastic strain and the cooling rate, are of importance and need to be optimised and controlled" to achieve the high potential strength of a martensitic steel (*i.e.*, minimize ferrite formation). *Id.* at 366. As one example, Somani found that a "tiny fraction of ferrite is formed [] at a cooling rate of 280°C/s after a plastic strain of 0.24." *Id*. at 367.

3. Engels

The Office has not previously considered Engels.

Engels discloses a coated steel product prepared from a base steel with an aluminum alloy pre-coating. Ex. 1041 at 136-37.

phase number	layer thickness, µm	Al	Fe	Si	Cr	Mn
		Volume-%				
1	5 – 9	7,2	89,2	1,9	0,3	1,4
2	< 1µm	unmeasurable				
3	11 – 18	51,4	45,9	1,9	0,1	0,7
4	3 – 8	33,9	54,3	10,6	0,3	0,9
5	5 - 11	53,2	44,1	1,9	0,2	0,6

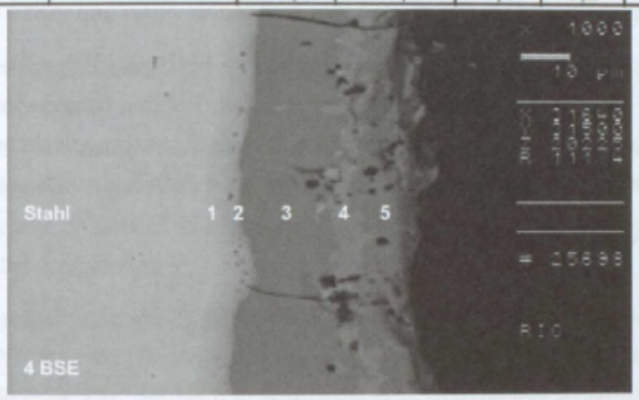


Figure 5. SEM micrograph of a cross-section polish of the diffusion layer

Engels, Ex. 1041, Figure 5

As shown in Figure 5, Engels' diffusion layer is composed of a succession of coating layers starting at the steel substrate. *See* Ex. 1044 (certifying that the term "Stahl" is a German word that translates to the English word "steel"). Notably, Engels' Figure 5 demonstrates that (i) the diffusion layer is approximately 40 µm thick and (ii) an interdiffusion layer adjacent to the base steel has a thickness less than 10 µm. Ex. 1003 at ¶ 32.

4. Nishibata

While Nishibata was cited by Patent Owner during prosecution, it was not applied by the Examiner. Furthermore, the combination of references relied upon herein (*e.g.*, Cornette in view of Nishibata) was not considered by the Examiner.

Nishibata discloses a coated steel product prepared from a base steel with an aluminum alloy pre-coating. *See* Ex. 1007 at 2. Notably, Nishibata discloses boron steels having 20 ppm or less of sulfur (S) by weight. *Id.* at 10.

5. Laurent

Laurent discloses a coated steel product prepared from a base steel with an aluminum alloy pre-coating. *See* Ex. 1008 at 1:47-48; 2:46-50. Laurent also discloses compositions of boron steels and aluminum (or aluminum alloy) pre-coatings. *See id*. at 1:47-64; 2:40-45.

During prosecution, Laurent was cited by Patent Owner and applied by the Examiner as an anticipatory reference against claim 1 and several dependent claims. Laurent, however, is not asserted against claim 1 in this Petition. Furthermore:

(i) there are material differences between the asserted art (Cornette) and Laurent (*e.g.*, Cornette explicitly recites a thickness of the coating after heat treatment, while Laurent lacks such explicit disclosure),

(ii) the asserted art is not cumulative (*e.g.*, Cornette includes a clear

scanning electron microscope (SEM) image of the coating after heat treatment (Figure 22), while Laurent lacks such an image),

(iii) the combination of references relied upon herein (e.g., Cornette in view of Laurent) was not considered by the Office,

(iv) there is minimal, if any, overlap between the arguments made during examination and the manner in which Petitioner relies on the prior art or Patent Owner distinguishes the prior art (e.g., Petitioner does not rely on Laurent for claim 1 or on In re Best, as relied on by the examiner during prosecution),

(v) the Examiner did not evaluate Cornette in view of Laurent (i.e., factor 5 of the Becton Dickinson favors consideration), and

(vi) the Petition includes additional arguments and expert testimony as to Laurent that warrant consideration.

See Becton, IPR2017-01586, Paper 8 at 17-18.

6. FR Laurent and EP Laurent

The Office has not previously considered FR Laurent. EP Laurent was cited by Patent Owner during prosecution but not applied by the Examiner. While FR and EP Laurent are similar to Laurent, they are all from different patent families, and have at least the following material differences: (i) FR Laurent explains that its aluminum-based coating is "about **25 µm** thick before thermal treatment" and that

a thickness of the aluminum-based coating has a "**50% increase**" resulting from "**interdiffusion**" caused by thermal treatment (Ex. 1010 at 5), and (ii) EP Laurent explains that a thickness of the aluminum-based coating before thermal treatment can range from **10-25 µm**. Ex. 1012 at ¶ 0011.

VI. LEVEL OF ORDINARY SKILL

A person having ordinary skill in the art ("PHOSITA") at the time of the alleged invention would have had at least an undergraduate degree in materials science, manufacturing engineering, mechanical engineering, or equivalent knowledge, training, or experience, with at least two years of experience working on the development of steels.

VII. CLAIM CONSTRUCTION

Petitioner submits the following proposed constructions:

A. "interdiffusion" (Claim 1)

Claim 1 recites "said coating **results from** the ***interdiffusion*** between said base steel, and aluminum or aluminum alloy pre-coating." Petitioner notes that while the specification of the '683 patent discusses an "interdiffusion layer" on multiple occasions, the '683 patent fails to recite, let alone define, the term "interdiffusion."[2] The term also has no well understood meaning in the art, and therefore warrants a construction. Ex. 1003 at ¶ 50.

[2] Petitioner reserves the right to argue indefiniteness in other forums.

The term "interdiffusion" is a combination of "inter" and "diffusion." "**Inter**" is a prefix taken from Latin, where it means "between" or "among," used in the formation of compound words. *See* Ex. 1026 at 955 (defining "inter" as "a prefix meaning *between*, *among*, as in *inter*flow, *inter*change"); Ex. 1027 at 991-92 (defining "inter" as "a prefix occurring in loanwords from Latin, where it meant 'between,' 'among,' 'in the midst of'"). As to "**diffusion**," dictionary definitions from the relevant period define "diffusion" as "the intermingling of the molecules of two or more substances." Ex. 1026 at 509; *see* Ex. 1028 at 119 (defining "diffusion" to mean "[t]he spontaneous movement of atoms or molecules to new sites within a material"); Ex. 1029 at 115 (defining "diffusion" as "[t]he process of transport of matter … activated through **thermal** agitation").

The '683 patent's discussion of "diffusion" aligns with the dictionary definitions provided above. For example, the patent explains that an "advantage of the invention lies in the fact that the ***diffusion* of the iron** in the coating is **initiated at high temperature**." Ex. 1001 at 10:34-36.

The '683 patent also explains that the "coating" results from "the pre-coating [] having been subjected to an **alliation reaction** between the pre-coating and base steel." Ex. 1001 at 15:4-5. According to the '683 patent, "alliation" refers to "a reaction between the pre-coating and base steel [that] produce[s] at least one intermediate layer different in composition from both the base steel and the pre-

coating." Ex. 1001 at 14:59-61. While Petitioner was unable to find a definition for "alliation" in English dictionaries, the term "alliation" is a French[3] word that translates to the English word "alloying." *See* Ex. 1031 (certifying that the French word "alliation" translates to the English word "alloying"). As such, a PHOSITA would have recognized that the '683 patent's "coating" results from an ***alloying reaction*** between a pre-coating and a base steel, which is consistent with other disclosures in the '683 patent. Ex. 1003 at ¶ 53.

As such, a PHOSITA would have understood "interdiffusion" to mean "intermingling of the molecules of two or more substances," which in the context of the '683 patent is caused by an alloying reaction. *Id*. at ¶ 54.

B. "wherein said coating comprises … (a) an *Interdiffusion layer*, (b) an *Intermediate layer*, (c) an *Intermetallic layer*, and (d) a *Superficial layer*"

Petitioner notes that while the claimed layer terms are capitalized, the specification does not provide definitions for these terms, and, instead, the terms are merely used to distinguish the respective layers from one another. Consequently, these terms must be given their plain and ordinary meaning as provided below.

1. "Interdiffusion layer" (Claim 1)

Per section VII.A, the term "interdiffusion" means "intermingling of the

[3] Listed inventors are French citizens.

molecules of two or more substances." Further, while "interdiffusion layer" has no well-understood meaning, "diffusion zone" and "diffusion layer" are terms referring to a layer formed adjacent to a base material due to diffusion. *See* Ex. 1038 at 180 (defining "diffusion zone" as "the zone of viable composition at the **junction** between different materials, such as … between the surface layer and the core of clad materials or bearings, in which **interdiffusion** between the various components has taken place"); Ex. 1039 at 327 (defining "diffusion layer" as "[i]n electrolysis, the layer of solution **adjacent** to the electrode").

As such, a PHOSITA would have understood "Interdiffusion layer" to mean "a layer, adjacent to a base material, formed from the intermingling of the molecules of two or more substances." Ex. 1003 at ¶ 57.

2. "Intermediate layer" (Claim 1)

While the '683 patent fails to define the term "intermediate," it has a plain and ordinary meaning. *See* Ex. 1026 at 958 (defining "intermediate" as "being or happening between, in the middle, between two extremes"); Ex. 1027 at 995 (defining "intermediate" as "being, situated, or acting between two points, stages, things, persons, etc.").

As such, a PHOSITA would have understood "Intermediate layer" to mean "a layer between two other layers." Ex. 1003 at ¶ 59.

3. "Intermetallic layer" (Claim 1)

While the '683 patent fails to define the term "intermetallic," it too has a plain and ordinary meaning. *See* Ex. 1040 at 1180 (defining "intermetallic" as "composed of two or more metals or of a metal and a nonmetal in an alloy").

As such, a PHOSITA would have understood "Intermetallic layer" to mean "a layer composed of two or more metals or of a metal and a nonmetal in an alloy." Ex. 1003 at ¶ 61.

4. "Superficial layer" (Claim 1)

While the '683 patent fails to define the term "superficial," it has a plain and ordinary meaning. *See* Ex. 1026 at 1828 (defining "superficial" as "lying on or pertaining to the superficies or surface").

As such, a PHOSITA would have understood "Superficial layer" to mean "a surface layer." Ex. 1003 at ¶ 63.

ARGUMENT

The Challenged Claims of the '683 patent are unpatentable in view of the prior art references discussed herein.

VIII. GROUND #1: CORNETTE ANTICIPATES CLAIMS 1-2

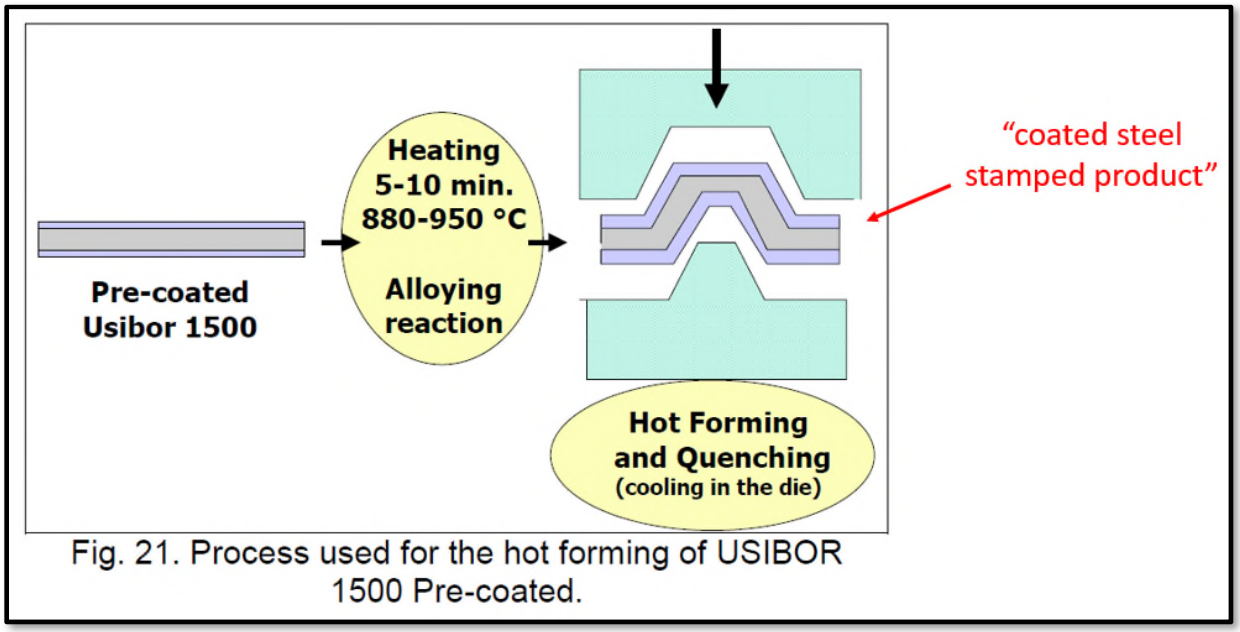
A. Claim 1

Cornette discloses each element of independent claim 1, which recites: [4]

[4] *See* Appendix A for the full claim set.

1. *"A coated steel stamped product, which comprises:"*

To the extent the preamble is a limitation of the claim, Cornette discloses a coated steel stamped product. Specifically, Cornette discloses that "**the text deals with a ultra high tensile strength *pre-coated* boron *steel* for hot *forming*.**" Ex. 1004 at 3; 9 (disclosing the "coating" of the pre-coated boron steel is "made of aluminum and silicon" and "is applied with a hot dipped process"); *id*. (stating "[Figure 22] shows a section view of the **coating *after* heat treatment**"). Cornette also discloses that its pre-coated boron steel can be used to "obtain complex parts, **by hot *stamping*.**" *Id*. at 11; *see* MPEP § 2125 ("Drawings and pictures can anticipate claims if they clearly show the structure which is claimed") (citing *In re Mraz*, 455 F.2d 1069 (C.C.P.A. 1972)).



Cornette, Ex. 1004, Figure 21

Cornette's Figure 21, above, shows a coated steel stamped product fashioned

through hot forming. Ex. 1003 at ¶ 68. As seen in Figure 21, the steel product (i) includes a coating (purple) on either side of a base steel (grey), and (ii) is hot formed via stamping and quenched/cooled in a die (blue). *Id*.

Thus, Cornette discloses a coated steel stamped product.

a. *"a strip of base steel having a first side and a second side"*

Cornette's coated steel stamped product includes a strip of base steel having a first side and a second side.

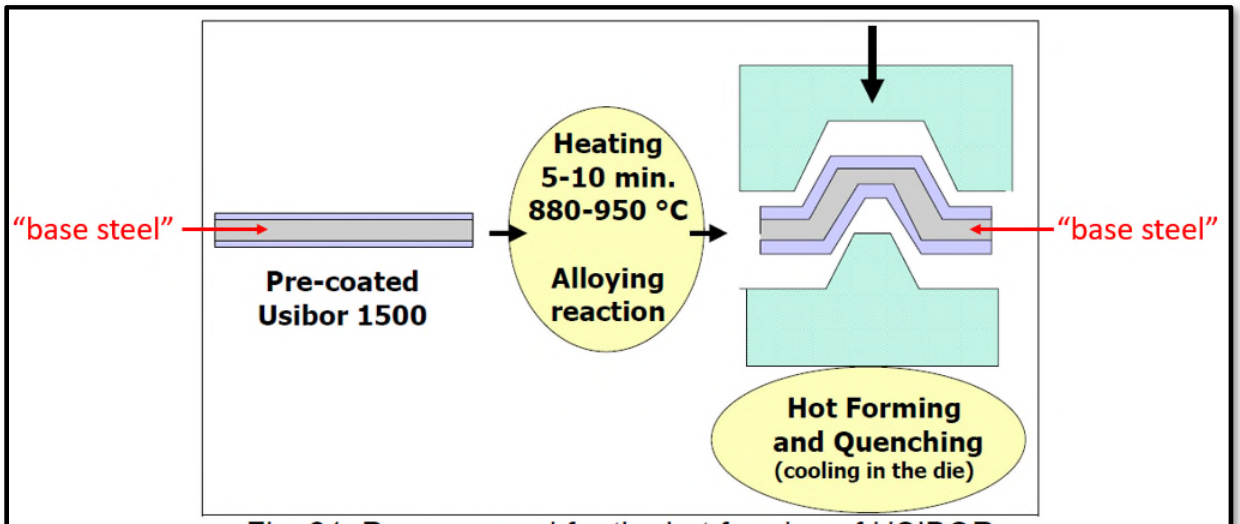


Fig. 21. Process used for the hot forming of USIBOR 1500 Pre-coated.

Cornette, Ex. 1004, Figure 21

As shown, Cornette's Figure 21 illustrates a pre-coated boron base steel (shown in grey) (*e.g.*, Usibor 1500) before heating (left) and after heating (right)—*i.e.*, the coated steel stamped product. *See* Ex. 1004 at 9 (caption reading "Fig. 21. Process used for hot forming of USIBOR 1500 Pre-coated"); Ex. 1003 at ¶ 71.

Each representation of the pre-coated steel in Figure 21 includes a strip of base steel with opposing top and bottom sides (*i.e.*, first and second sides) each coated with a coating. *Id*. Thus, Cornette's Figure 21 alone establishes that Cornette's coated steel stamped product includes a strip of base steel having first and second sides. *Id*.

Moreover, the section in which Figure 21 appears and the surrounding text confirm that Figure 21 shows a strip of **steel** (*e.g.*, grey material in Figure 21) having first and second sides. For example, Figure 21 appears in the section titled "PRE-COATED BORON **STEEL**," which is directed toward a "**pre-coated version of USIBOR []** ***steel***" suited for press/stamp hardening processes. Ex. 1004 at 9. Further, the subsection immediately following Figure 21 titled the "CHEMICAL COMPOSITION OF THE **BASE MATERIAL**" provides that "USIBOR 1500 is a carbon-manganese **steel** microalloyed with boron." *Id*. at 9; *see id*. (disclosing that "[h]eating the pre-coated boron **steel** (generally 900°C, 5 minutes) creates an alloying reaction between ***substrate* (*iron*)** and the coating (aluminum - silicon)").

Cornette also discloses mechanical characteristics for a coated steel stamped product obtained through testing a 20x80 mm piece of steel (*i.e.*, a strip of steel) *See* Ex. 1004 at 10 (listing mechanical characteristics of a piece of steel after hot forming using a "ISO 20x80 type" test); Ex. 1003 at ¶ 73 (citing Ex. 1036 as

corroborating evidence).

Therefore, Cornette discloses "a strip of base steel [*e.g.*, Usibor 1500] having a first side and a second side."[5]

b. *"a coating on at least one of said first side of said strip of base steel and said second side of said strip of base steel"*

Cornette's coated steel stamped product includes a coating on both sides of the strip of base steel.

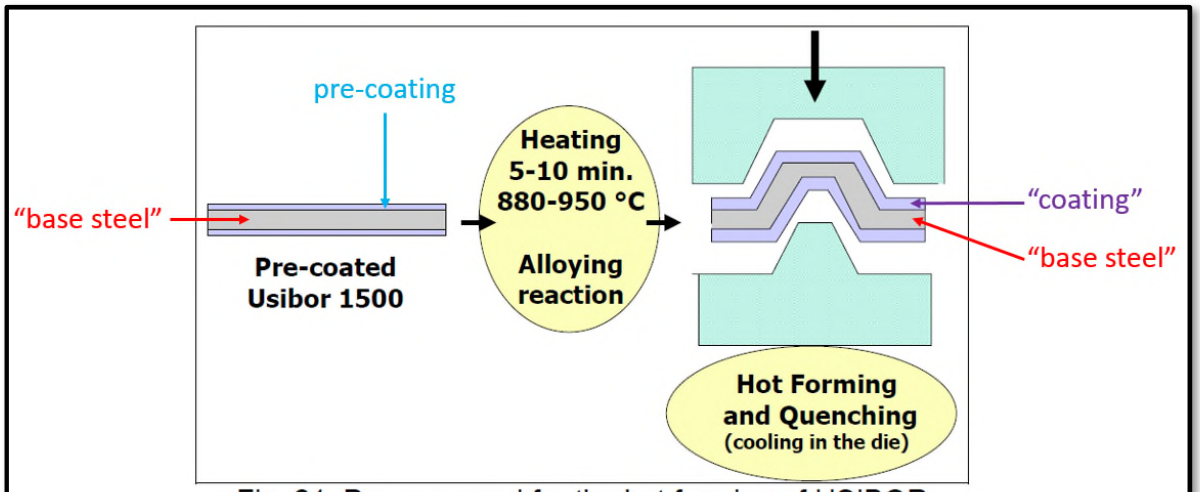


Fig. 21. Process used for the hot forming of USIBOR 1500 Pre-coated.

Cornette, Ex. 1004, Figure 21

As shown above, Cornette's Figure 21 illustrates a pre-coated boron base

[5] Claim 1 does not impose any size limitations on the "strip of base steel." As such, a section of Cornette's SEM image in Figure 22 (Section view) corresponds to the claimed strip of base steel and coating, as does the entire SEM image.

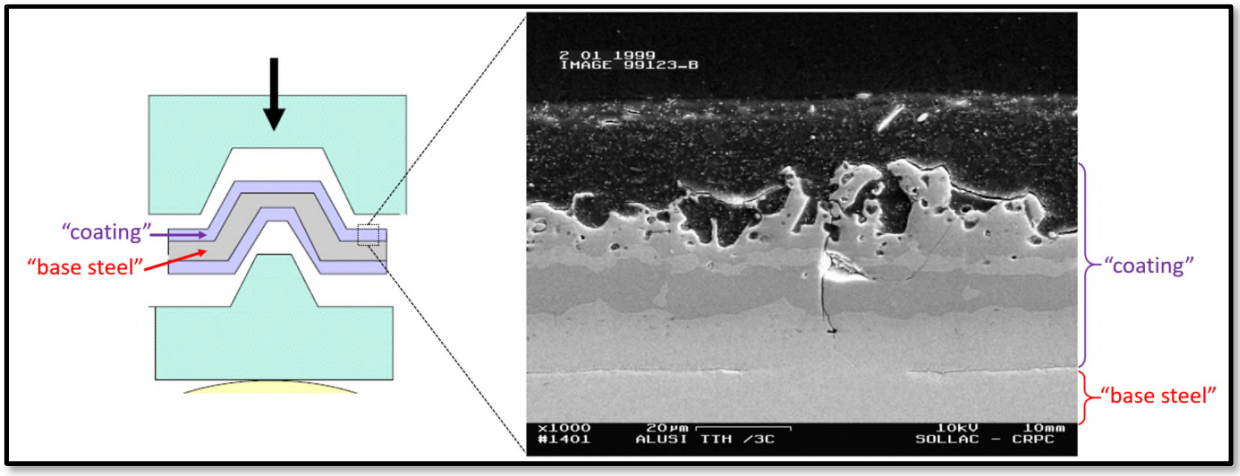
steel (*e.g.*, Usibor 1500) before heating (left) and after heating (right). Ex. 1003 at ¶ 76. Each representation of the boron steel in Figure 21 includes a strip of base steel coated on both sides with a coating. *Id*. Thus, Cornette's Figure 21 alone establishes that Cornette discloses a coating on at least one side of a base steel. *Id*. Additional descriptions in the "PRE-COATED BORON STEEL" section of Cornette confirm that Cornette teaches this element.

First, a subsection following Figure 21 titled "DESCRIPTION OF THE **COATING**" provides that (i) the "coating, made of aluminum and silicon, is applied [to the base steel] with a hot dipped process" and (ii) "[h]eating the pre-coated boron steel (generally 900°C, 5 minutes) creates an alloying reaction between substrate (iron) and the coating (aluminum - silicon) which leads to a hard **multiphase alloy layer** [at the steel surface]." Ex. 1004 at 9; *see id*. (stating that "**Fe-Al-Si layer** is typically about 40 μm **at the steel surface**").[6]

Second, Cornette's Figure 22 shows the coating formed on the base steel **after** heat treatment. *Id*. at 9-10 (stating "[t]he following photo [in Figure 22] shows a section view of the **coating *after* heat treatment**"). Note that Figure 22 is

[6] Cornette uses the phrases "multiphase alloy layer" and "Fe-Al-Si layer" interchangeably, and these two terms correspond to the claimed "coating." Ex. 1003 at ¶ 77, n. 3.

shown with Figure 21, below, to provide context to the SEM image of Figure 22.



<u>Cornette, Ex. 1004, Figures 21 and 22</u>

Thus, the text and figures following Figure 21 confirm that the coating (*i.e.*, the multiphase alloy layer) is formed on **at least one side** of the strip of base steel.

As such, Cornette discloses "a coating [*e.g.*, the "multiphase alloy layer"/ "Fe-Al-Si layer"] on at least one of said first side of said strip of base steel and said second side of said strip of base steel."

c. *"wherein: (i) said coating results from the interdiffusion between said base steel, and aluminum or aluminum alloy pre-coating"*

Per section VII.A, incorporated here, "interdiffusion" means "intermingling of the molecules of two or more substances."

Cornette discloses that the coating (*i.e.*, the "multiphase alloy layer") results from the interdiffusion between the base steel and the aluminum or aluminum alloy pre-coating.

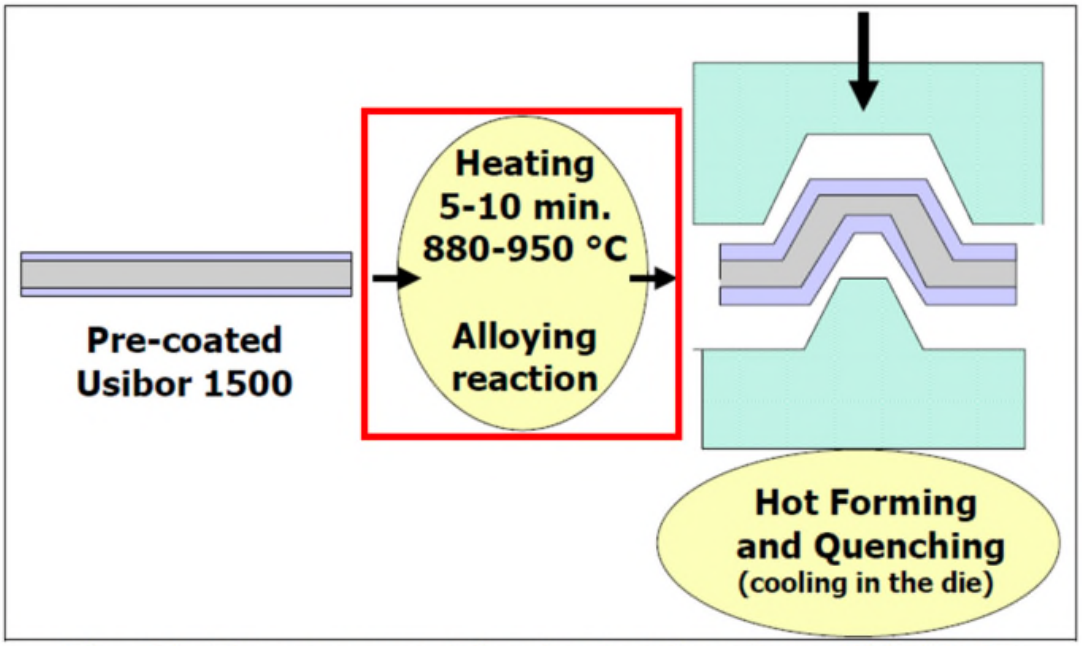


Fig. 21. Process used for the hot forming of USIBOR 1500 Pre-coated.

Cornette, Ex. 1004, Figure 21

Cornette's Figure 21, above, shows that Cornette's hot forming process includes an **alloying reaction** (*i.e.*, an alliation reaction). Specifically, Cornette discloses that (i) its "coating [is] made of aluminum and silicon" and (ii) "[h]eating the pre-coated boron steel (generally 900°C, 5 minutes) creates an ***alloying reaction*** **between substrate (iron) and the coating (aluminum - silicon)** ***which leads to*** **a hard multiphase alloy layer**." Ex. 1004 at 9; *cf.* Ex. 1001 at 6:17-22 ("It must be pointed out that this coating [*i.e.*, the claimed "coating"] is different from the initial pre-coating, since the **thermal treatment causes an** ***alloying reaction*** **with the steel substrate** ***which modifies*** **both the physico-chemical nature and the geometry of the pre-coating**"); 10:34-36 ("Another advantage of

the invention lies in the fact that the **diffusion of the iron** in the coating is initiated at high temperature"). Cornette provides additional details showing ***interdiffusion*** between the base steel and the pre-coating.

First, Cornette explains that the coating (*i.e.*, the **pre-coating**) before heat treatment has an average thickness of **25 µm**, while the hard multiphase alloy layer (*i.e.*, the **coating after heat treatment**), which Cornette also refers to as the Fe-Al-Si layer, "is **typically about 40 µm** at the steel surface." Ex. 1004 at 9. Therefore, heating the pre-coated boron steel causes the pre-coating in Cornette to diffuse or mix into the base steel, thereby increasing the thickness of the coating. Ex. 1003 at ¶ 84 (citing Ex. 1010 as corroborating evidence).

Second, Cornette's coating (*i.e.*, the pre-coating) before heat treatment includes aluminum and silicon while the coating after heat treatment includes aluminum (Al), silicon (Si), **and iron (Fe)**. *See* Ex. 1004 at 9 (disclosing that the "coating [is] made of aluminum and silicon"); *id*. (disclosing that the "**Fe**-Al-Si layer is typically about 40 µm at the steel surface"); Ex. 1003 at ¶ 86. Therefore, a PHOSITA would have appreciated that heating the pre-coated boron steel causes, at a minimum, iron diffusion from the base steel to the coating and *vice versa* (*i.e.*, the materials mix into each other). *Id*.

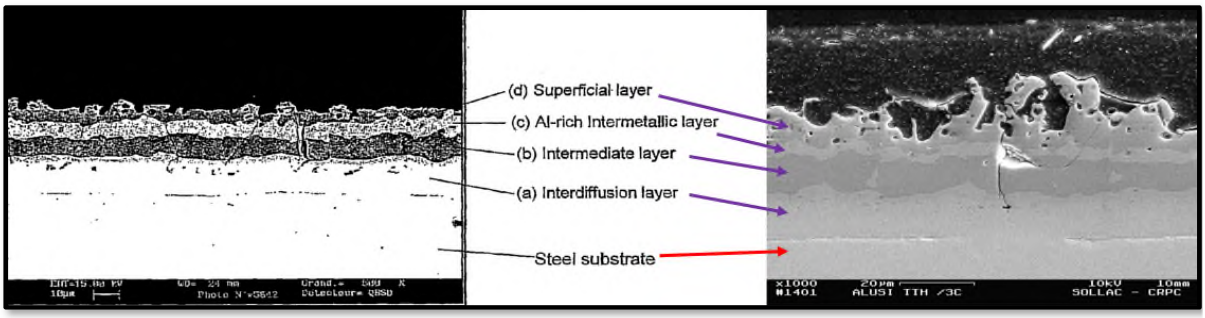
Therefore, Cornette discloses "wherein: (i) said coating results from the interdiffusion between said base steel, and aluminum or aluminum alloy pre-

coating [*e.g.*, the hard multiphase alloy layer results from the alloying reaction between substrate (iron) and the coating (aluminum - silicon)]."

d. *"wherein said coating comprises, proceeding from the base steel outwards: (a) an Interdiffusion layer, (b) an Intermediate layer, (c) an Intermetallic layer, and (d) a Superficial layer"*

Per section VII.B, incorporated here, "Interdiffusion layer" means "a layer, adjacent to a base material, formed from the intermingling of the molecules of two or more substances"; "Intermediate layer" means "a layer between two other layers"; "Intermetallic layer" means "a layer composed of two or more metals or of a metal and a nonmetal in an alloy"; and "Superficial layer" means "a surface layer."

Cornette discloses that the coating (*i.e.*, the "**multi*phase* alloy** layer") comprises, proceeding from the base steel outwards: (a) an Interdiffusion layer, (b) an Intermediate layer, (c) an Intermetallic layer, and (d) a Superficial layer.

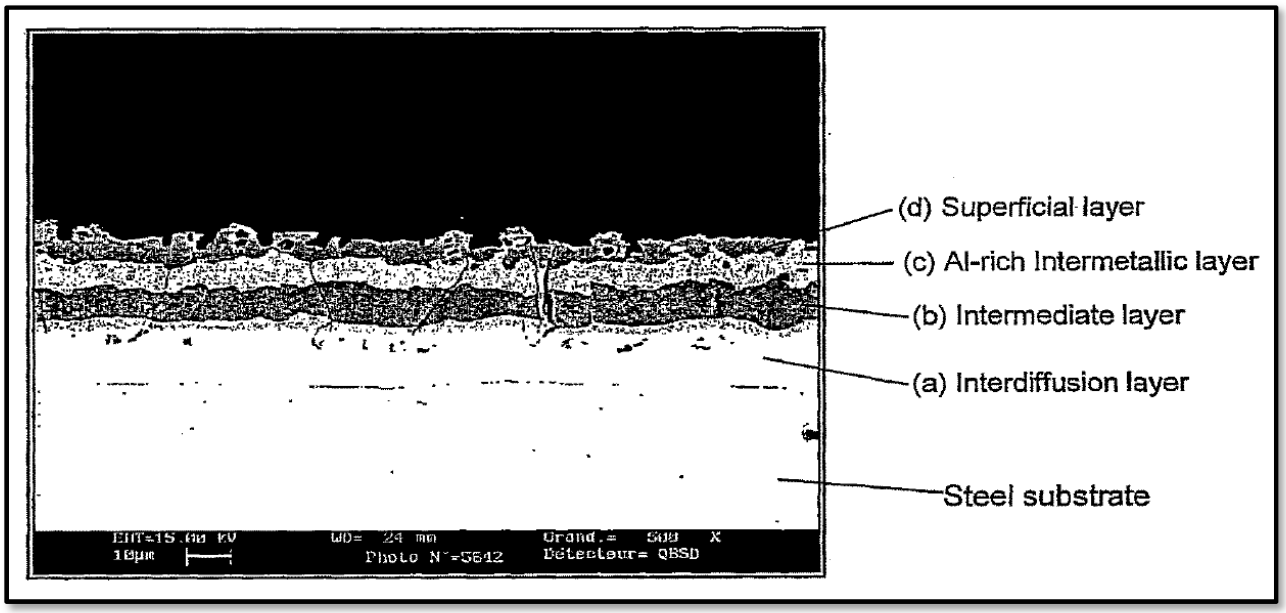


'683 Patent, Ex. 1001, Fig. 1 **Cornette, Ex. 1004, Fig. 22**

Cornette's Figure 22 shows "a section view of the coating after heat treatment" (*i.e.*, showing the "multiphase alloy layer" resulting from the alloying reaction).

Ex. 1004 at 9. Notably, just like Figure 1 from the ’683 patent, Figure 22 shows that the multiphase alloy layer formed at the steel surface includes four distinct phases/layers (*i.e.*, an interdiffusion layer, an intermediate layer, an intermetallic layer, and a superficial layer). Ex. 1003 at ¶ 88.

While the four phases/layers are not labeled in Cornette’s Figure 22, Dr. Miles explains that a PHOSITA would have understood that these phases/layers correspond to the claimed interdiffusion layer, intermediate layer, intermetallic layer, and superficial layer, as those terms are used in the ’683 patent. *Id*. at ¶ 89. For example, the materials and process are the same, and the color scheme and arrangement of the four phases/layers mirror the color scheme and arrangement of the phases/layers shown in Figure 1 of the ’683 patent.



<u>’683 Patent, Ex. 1001, Figure 1</u>

As shown above, the “Steel substrate” and the “Interdiffusion layer” in

Figure 1 of the ’683 patent are essentially the same color and can be distinguished from each other by a roughly horizontal line. Further, the ’683 patent describes the “Intermediate layer” as “appearing **darker**,” the “Intermetallic layer” as “appearing as a **pale phase**” (*i.e.*, appearing lighter), and the “Superficial layer” as the “**Darker** superficial layer.” Ex. 1001 at 12:65-13:5.

This is exactly the same in Cornette’s Figure 22, *i.e.*, the “steel substrate” and the “interdiffusion layer” are essentially the same color and can be distinguished from each other by a roughly horizontal line; the “intermediate layer” and “superficial layer” are darker (*e.g.*, than adjacent layers/phases); and the “intermetallic layer” is pale (*e.g.*, relative to adjacent layers/phases). Thus, the four phases/layers shown in Cornette’s Figure 22 match the claimed interdiffusion layer, intermediate layer, intermetallic layer, and superficial layer of the ’683 patent. Ex. 1003 at ¶ 91.

Furthermore, and just like the ’683 patent, Cornette’s multiphase alloy layer has a **four-layer structure**, including an interdiffusion layer adjacent to the Usibor 1500 base steel, two layers—the intermediate layer and the intermetallic layer—that are between other layers, and a surface/superficial layer. *Cf.* Ex. 1001 at 12:55-58 (explaining that parts obtained after hot-stamping using conditions according to the invention have “**a four layer structure**”).

Moreover, Cornette identifies its four-layer structure as an “Fe-Al-Si layer,”

demonstrating that iron (Fe) from the base steel intermixed/intermingled with the aluminum (Al) and silicon (Si) of the pre-coating, and *vice versa*, throughout the multiphase alloy layer. Ex. 1003 at ¶ 93. Thus, in Cornette's multiphase alloy layer (*i.e.*, the Fe-Al-Si layer), the layer adjacent to the base steel (*i.e.*, the interdiffusion layer) is formed from the intermingling of the molecules of two or more substances (*e.g.*, the base steel and coating).

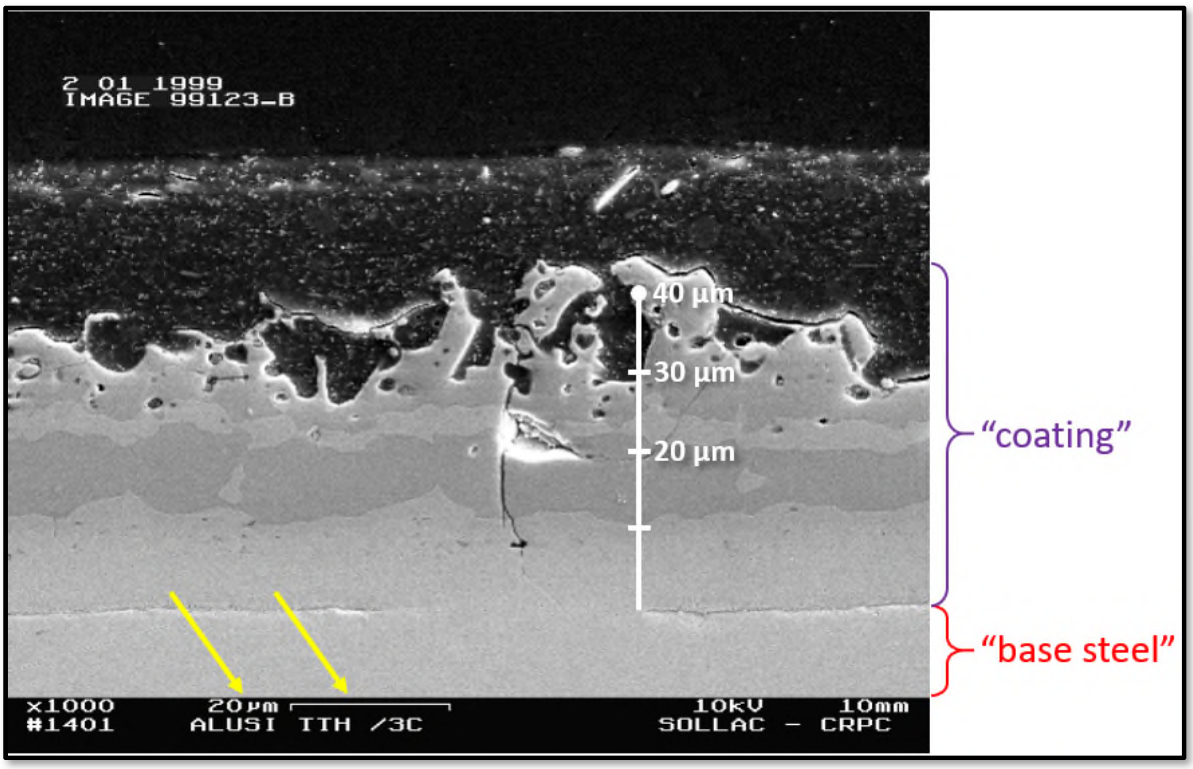
As discussed above, the claimed "Intermetallic layer" is a layer composed of two or more metals or of a metal and a nonmetal in an alloy. As Cornette's "multiphase alloy layer" is composed of two or more metals or of a metal and a nonmetal (*e.g.*, silicon) in an alloy (*i.e.*, the "**Fe-Al-Si** layer is typically about 40 μm at the steel surface," Ex. 1004 at 9), Cornette discloses the "Intermetallic layer." *Cf.* Ex. 1001 at 6:31-53 (disclosing that each layer, including the "Intermetallic layer," is composed of **Fe**, **Al**, and **Si)**; Ex. 1003 at ¶ 94.

As such, Cornette discloses "wherein said coating [*e.g.*, the multiphase alloy layer] comprises, proceeding from the base steel outwards: (a) an Interdiffusion layer, (b) an Intermediate layer, (c) an Intermetallic layer, and (d) a Superficial layer [*e.g.*, the four successive phases/layers shown in Cornette's Figure 22]." *See id*. at ¶¶ 95-96.

e. *"wherein said coating has a thickness greater than 30 micrometers"*

Cornette discloses that the coating in the final coated steel stamped product

has a thickness **greater than 30 micrometers**. Specifically, Cornette discloses "[h]eating the pre-coated boron steel (generally 900°C, 5 minutes) creates an alloying reaction between substrate (iron) and the coating (aluminum - silicon) which leads to a hard **multiphase alloy layer**," which "is typically **about 40 µm at the steel surface**." Ex. 1004 at 9. Cornette's Figure 22 (below) shows a section view of the coating and base steel after heat treatment:



Cornette, Ex. 1004, Figure 22 (Section view)

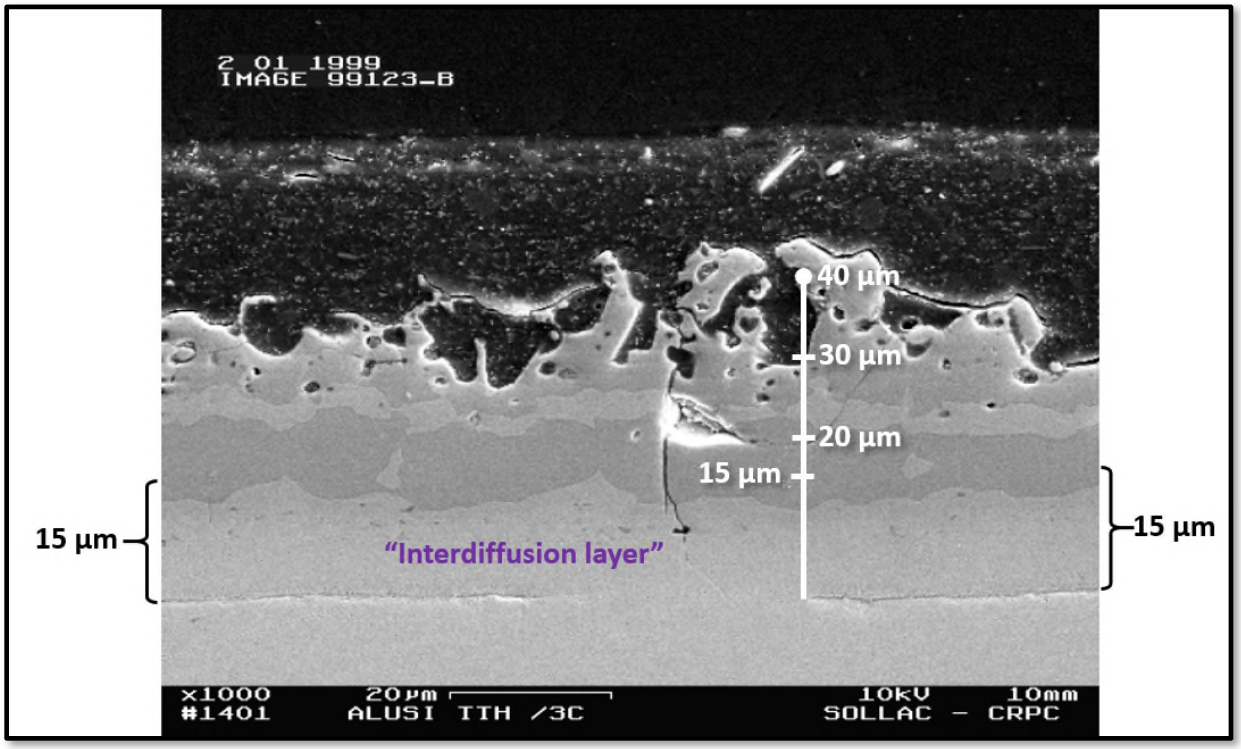
This figure is consistent with Cornette's disclosure of a coating after heat treatment with a thickness of about 40 µm at the steel surface. Ex. 1004 at 9-10. In the illustrated example, Cornette's multiphase alloy layer (labeled as the "coating") has a thickness of about 40 µm at the annotated location (and numerous

other locations). Petitioner notes that measurement annotations on Figure 22 above were obtained using the 20 µm scale provided in Figure 22 (highlighted by the yellow arrows). *See* MPEP § 2125; *cf.* Ex. 1001 at Figure 1 (reproducing Figure 1's 10 µm scale, indicating that Patent Owner itself believed the scale of an SEM image to be important and accurate); Ex. 1003 at ¶ 98.

As such, Cornette discloses "wherein said coating [*e.g.*, the multiphase alloy layer] has a thickness greater than 30 micrometers [*e.g.*, typically about 40 µm]."

f. *"wherein said layer (a) has a thickness less than 15 micrometers"*

Cornette also discloses that the layer next to the base steel, *i.e.*, the claimed "Interdiffusion layer," has a thickness **less than 15 µm**.



Cornette, Ex. 1004, Figure 22 (Section view)

As shown in Figure 22, above, Cornette's multiphase alloy layer includes an "Interdiffusion layer" with a thickness that is less than 15 μm at the annotated location (same location discussed in section VIII.A.1.e). Ex. 1003 at ¶ 101. Petitioner notes that measurement annotations on Figure 22 above were obtained using the 20 μm scale provided in Figure 22 of Cornette. Petitioner further notes that the '683 patent does not provide any different meaning for the well-known term "thickness," and therefore, a layer with any portion having a thickness value that is less than 15 μm satisfies this claim element. *Id*. Again, as shown above, Cornette's interdiffusion layer has a thickness less than 15 μm at the annotated location (and numerous other locations in this portion shown by the SEM image).

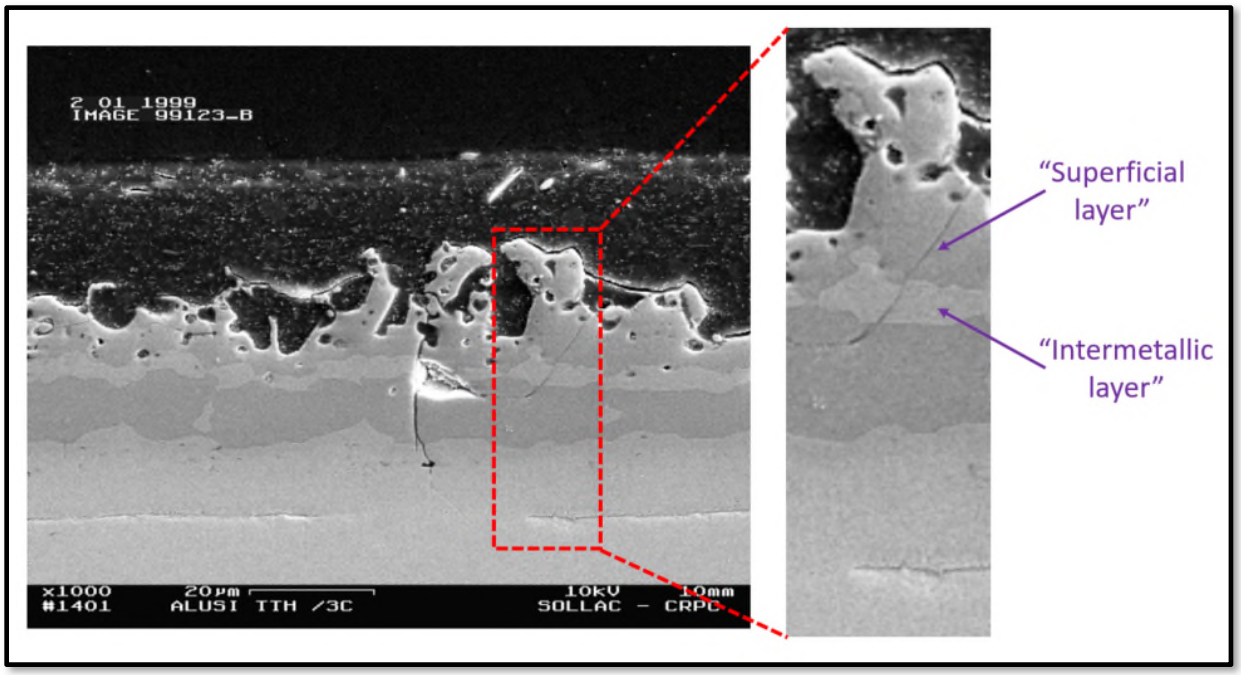
As such, Cornette discloses "wherein said layer (a) has a thickness less than 15 micrometers."

Accordingly, because Cornette discloses each element of claim 1, claim 1 is anticipated by Cornette.

B. <u>Claim 2</u>

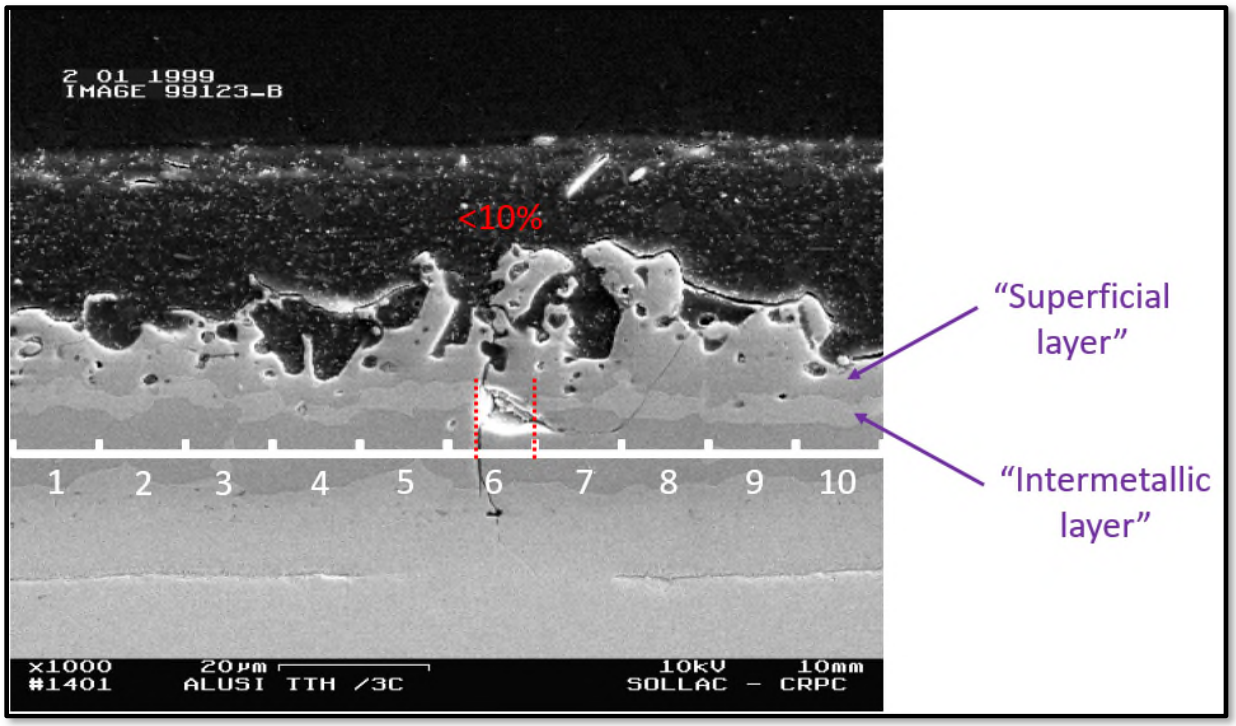
Claim 2 depends from claim 1 and adds "[2a] wherein the said layers (c) and (d) are quasi continuous by occupying at least 90% of a level corresponding to each said layer" and "[2b] wherein less than 10% of layer (c) is present at an extreme surface of the product."

Cornette discloses element [2a].



Cornette, Figure 22 (Section view)

As shown above, in Cornette's multiphase alloy layer, the "Superficial layer" and "Intermetallic layer" extend continuously or essentially continuously (*e.g.*, as illustrated in the segment of Figure 22 enlarged above). Claim 2 merely refers to "a level corresponding to each said layer" and, thus, the enlarged segment of Figure 22 above demonstrates "a level" of Cornette's layer (c) and layer (d).



Cornette, Figure 22 (Section view)

Even across the entire SEM image in Figure 22 above, the "Superficial layer" and "Intermetallic layer" extend continuously or essentially continuously across the **entire image** (as shown above), except perhaps for one segment of the intermetallic layer, shown between the dotted red lines. This segment, however, occupies less than 10% of the intermetallic layer shown in the image (which marks off every 10%). Therefore, Cornette's intermetallic layer is "quasi continuous." Ex. 1003 at ¶ 107. Petitioner also notes that the annotated segment above appears to be an artifact, made post-processing, which would mean that Cornette's intermetallic layer *was* fully continuous after processing. *Id.*

As to element [2b], Cornette's "Intermetallic layer" does not extend to the

outer surface of the product, as shown in Figure 22 above (*e.g.*, the pale color of the "Intermetallic layer" does not penetrate through the darker "Superficial layer"). Therefore, Cornette also discloses this element of claim 2 (*i.e.*, the "Superficial layer" is continuous). *Id.* at ¶ 108.

In view of the above, Cornette anticipates claim 2.

IX. GROUND #2: CORNETTE RENDERS OBVIOUS CLAIMS 8 AND 11

A. Claim 8

Claim 8 depends from claim 1 and adds "[a] **land motor vehicle** comprising the heat treated coated steel product according to claim 1."

Cornette describes steels used to create components for automobiles. *See*, *e.g.*, Ex. 1004 at 1 (Title: "High Strength Steels for **Automotive** Safety Parts"); 11 ("Pre-coated boron steel enable to obtain **complex [automotive] parts**, by hot stamping"); 12 (describing a bumper beam of a vehicle that is formed by "hot stamping and quench of boron steel"); 3 ("The process used for the hot forming of Boron steel permits good formability and very good in-use properties. **This ultra high strength steel enables complex parts**"); 10-11 (noting that the "[c]orrosion resistance" of coated boron steel after heat treatment "is compatible with most **car makers** requirements").

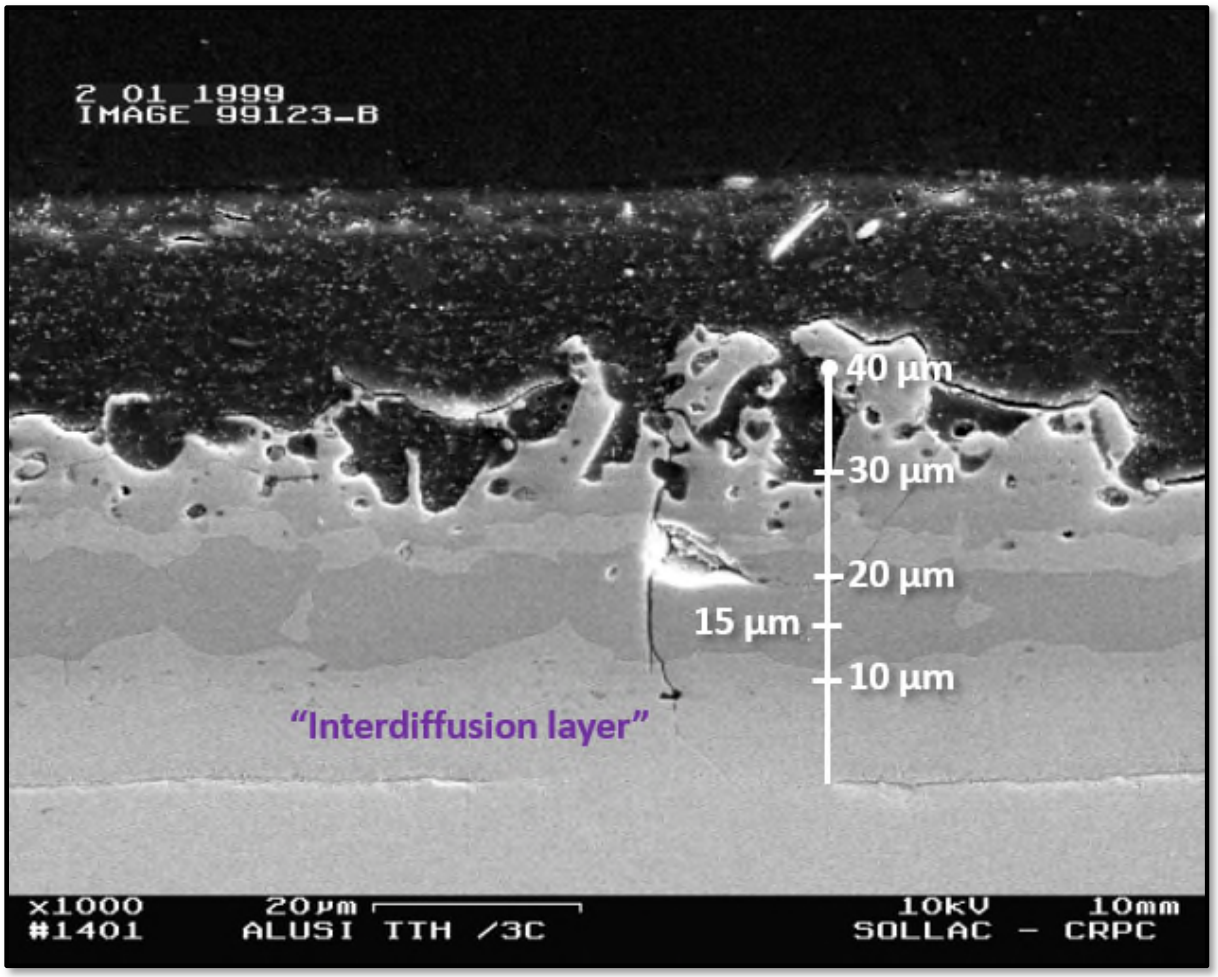
Accordingly, a PHOSITA would have understood that the components described in Cornette, including a hot-stamped component made from pre-coated

boron steels (*e.g.*, Usibor 1500), are to be incorporated into an automobile/car, *i.e.*, a land motor vehicle. Ex. 1003 at ¶ 112. A PHOSITA would have been motivated to include Cornette's heat treated steel stamped product in a land motor vehicle because: (i) Cornette says to do so, (ii) pre-coated boron steels have "high mechanical characteristics authorizing a **significant lightening**," (iii) no costly **pickling operation** is required after hot forming, and (iv) stamped parts are **corrosion resistant** (*i.e.*, avoid additional hot dipped or electro-coating operation to achieve corrosion resistance), all of which are desirable outcomes. Ex. 1004 at 11; Ex. 1003 at ¶ 112.

As such, Cornette renders claim 8 obvious.

B. <u>Claim 11</u>

Claim 11 depends from claim 1 and adds "wherein said layer (a) has a thickness less than 10 micrometers."



Cornette, Figure 22 (Section view)

As shown in Figure 22, above, Cornette's "interdiffusion layer" has a thickness *very close to* 10 µm (*e.g.*, approximately 10.5 µm in at least one location). Ex. 1003 at ¶ 115. According to the MPEP, "a *prima facie* case of obviousness exists where the claimed ranges or amounts do not overlap with the prior art but are merely close." MPEP § 2144.05 (citing *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 783 (Fed. Cir. 1985)). In *Titanium Metals*, the Federal Circuit found a claim directed to an alloy "having 0.8% nickel, 0.3%

molybdenum, up to 0.1% iron, balance titanium" to be rendered obvious by a reference disclosing alloys of 0.75% nickel, 0.25% molybdenum, balance titanium and 0.94% nickel, 0.31% molybdenum, balance titanium. *Id*. There, the Court reasoned that the "proportions ***are so close*** that prima facie one skilled in the art would have expected them to have the same properties." *Id*.

Likewise, here, a thickness of Cornette's interdiffusion layer (*e.g.*, approximately 10.5 μm at the annotated location) is so close to the claimed thickness that one skilled in the art would have expected them to have the same properties. Ex. 1003 at ¶ 116. This contention is supported by the '683 patent's failure to discuss how reducing the interdiffusion layer's thickness (*e.g.*, from 15 μm to less than 10 μm, let alone from 10.5 μm to less than 10 μm) would cause meaningful changes in the interdiffusion layer (or the coating as a whole) *i.e.*, the thickness size is not critical to the '683 patent. *See* Ex. 1001 at 6:56-61 (failing to provide any details about the interdiffusion layer other than preferred thicknesses); *see also In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990) ("The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims … **[I]n such a situation, the applicant <u>must show</u> that the particular range is *critical*, generally by showing that the claimed range *achieves unexpected results relative to the prior art range*.**").

Rather, the ’683 patent demonstrates to a PHOSITA that an interdiffusion layer thickness of less than 10 μm is not critical to the invention. In fact, the patent itself highlights that any number of thicknesses are suitable: “the thickness of layer (a) is less than 15 micrometers, for example 14, 12, 10, 8, 6, 4, 2, or 1 micrometers, and all whole numbers, ranges and subranges therebetween, and including all numbers between each listed value as if written out in its entirety (e.g., 13.84 micrometers).” Ex. 1001 at 6:56-61; Ex. 1003 at ¶ 117. Thus, a PHOSITA would have understood from the ’683 patent that an interdiffusion layer of less than 10 μm is not critical.

In view of the above, Cornette renders claim 11 obvious.

In addition, as explained by Dr. Miles, it would have been obvious for a PHOSITA to slightly reduce a thickness of Cornette’s multiphase alloy layer and, in turn, the interdiffusion layer by adjusting the heat treatment applied to Cornette’s pre-coated boron steel. Ex. 1003 at ¶ 119-121. Dr. Miles attests that a PHOSITA would have been able to achieve said reduction in thickness through routine experimentation, and would have expected a successful result. *Id*. at ¶ 120.

X. GROUND #3: CORNETTE IN VIEW OF LAURENT RENDERS DEPENDENT CLAIMS 3-4, 6-7, AND 10 OBVIOUS

A. Claim 3

Claim 3 depends from claim 1. The table below compares the claimed ranges against values disclosed by Laurent. *See* Appendix A for claim language.

Claimed Ranges of the Claimed Steel	**Values of Laurent's Disclosed Steel**	**Met by Laurent?**
0.15%<carbon<0.5%	carbon=0.21%	✓
0.5%<manganese<3%	manganese=1.14%	✓
0.1%<silicon<0.5%	silicon=0.25%	✓
0.01%<chromium<1%	chromium=0.18%	✓
titanium<0.2%	titanium=0.032%	✓
aluminum<0.1%	aluminum=0.04%	✓
phosphorus<0.1%	phosphorus=0.02%	✓
sulfur<0.05%	sulfur=0.0038%	✓
0.0005%<boron<0.08%	boron=0.003%	✓

See Ex. 1008 at 3:38-42.

As shown above, each value for the base steel composition disclosed by Laurent is within the corresponding claimed range. *See Titanium Metals*, 778 F.2d at 782 ("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.") (emphasis in original).[7]

[7] A chemical composition of the underlying base steel would not change as a result of the added coating, heat treatment, and stamping. Ex. 1003 at ¶ 124, n. 4.

Claim 3 also recites "further compris[ing] **iron and impurities inherent** in processing." For this, Laurent discloses "the steel in the sheet having the following composition by weight …" with "the **remainder being *iron* and *impurities* inherent in processing**." Ex. 1008 at 1:48-61.

Thus, Laurent discloses the elements of claim 3.

B. <u>Claim 4</u>

Claim 4 depends from claim 1. The table below compares the claimed ranges against values disclosed by Laurent. *See* Appendix A for claim language.

Claimed Ranges of the Claimed Steel	**Values of Laurent's Disclosed Steel**	**Met by Laurent?**
0.2%<carbon<0.5%	carbon=0.21%	✓
0.8%<manganese<1.5%	manganese=1.14%	✓
0.1%<silicon<0.35%	silicon=0.25%	✓
0.01%<chromium<1%	chromium=0.18%	✓
titanium<0.1%	titanium=0.032%	✓
aluminum<0.1%	aluminum=0.04%	✓
phosphorus<0.05%	phosphorus=0.02%	✓
sulfur<0.03%	sulfur=0.0038%	✓
0.0005%<boron<0.01%	boron=0.003%	✓

See Ex. 1008 at 3:38-42.

As shown above, each value disclosed by Laurent is within the corresponding claimed range.

Claim 4 also recites "further compris[ing] iron and impurities inherent in processing." Laurent discloses this portion of claim 4 for the reasons stated in section X.A, incorporated here.

There are many reasons why a PHOSITA would have looked to other references, such as Laurent, and would have been motivated to modify Cornette based on the teachings of those references. *First*, Cornette and Laurent are in the **same field of endeavor** as the '683 patent (*i.e.*, pre-coated boron steels used for automotive parts). *See* Ex. 1008 at 2:30-34 (disclosing "[t]he invention also concerns the use of the hot-rolled steel sheet which then can be cold-rolled and **coated**, for structural and/or anti-intrusion or substructure castings for a land motor vehicle, such as, for example, a bumper bar, a door reinforcement, a wheel spoke").[8] Moreover, as mentioned earlier, the '683 patent admits that Laurent discloses pre-coated steels in hot-stamping processes for the shaping of parts in the automotive industry. Ex. 1001 at 1:40-52; Ex. 1003 at ¶ 130.

Second, Cornette does not disclose *specific values* for each component of the

[8] This is not surprising as Cornette and Laurent share a common contributor: Jean-Pierre Laurent.

pre-coated boron steel (*i.e.*, Usibor 1500). Rather, Cornette discloses an acceptable *range* for each component (*e.g.*, carbon, manganese, silicon, etc.) of the pre-coated boron steel. A PHOSITA wanting to make a specific coated steel stamped product, as described by Cornette, would thus be motivated to look to another reference, such as Laurent, that discloses the specific values for the components (*e.g.*, carbon, manganese, silicon, etc.) of a base steel. Ex. 1003 at ¶ 131.

Third, the specific values disclosed by Laurent fall exactly within Cornette's acceptable ranges from Table III, as shown in the table below.

Cornette Ranges	**Laurent Values**	
0.2%≤carbon≤0.25%	carbon=0.21%	✓
1.1%≤manganese≤1.35%	manganese=1.14%	✓
0.15%≤silicon≤0.35%	silicon=0.25%	✓
0.15%≤chromium≤0.3%	chromium=0.18%	✓
0.02%≤titanium≤0.05%	titanium=0.032%	✓
0.02%≤aluminum≤0.06%	aluminum=0.04%	✓
sulfur≤0.008%	sulfur=0.0038%	✓
0.002%≤boron≤0.004%	boron=0.003%	✓

In light of this, a PHOSITA would have expected that the proposed combination of Cornette and Laurent would yield predictable and successful results (*e.g.*, a coated steel stamped product having the advantages as described by

Cornette). *Id*. at ¶ 133. Moreover, a PHOSITA would have been motivated to use the specific values disclosed by Laurent to avoid experimenting with the ranges disclosed by Cornette (*i.e.*, the coated steel stamped product would also have the advantages described in Laurent). *Id*. Put another way, because Cornette discloses an acceptable *range* for each component (*e.g.*, carbon, manganese, silicon, etc.) of the pre-coated boron steel, and because the specific values disclosed by Laurent fall exactly within Cornette's acceptable ranges, it would have been obvious for a PHOSITA to try using Laurent's base steel as he/she would have had a reasonable expectation of success in doing so. *Id*.

Thus, Cornette in view of Laurent renders claims 3 and 4 obvious.

C. <u>Claim 6</u>

1. Laurent Teaches This Limitation

Claim 6 depends from claim 1 and adds "wherein the **ratio of titanium to nitrogen** in the base steel in **weight % is in excess of 3.42**." While Cornette discloses the claimed titanium in its base steel, Cornette fails to discuss nitrogen.

Laurent, however, discloses the exact same subject matter, explaining that "in the composition by weight of the sheet, **the titanium content with respect to the nitrogen content is in excess of 3.42**." Ex. 1008 at 2:11-14; claim 5 ("The coated steel sheet according to claim 1, wherein the ratio of titanium to nitrogen in the steel sheet in weight % is in excess of 3.42."). Laurent further discloses a

specific example of a base steel sheet having a titanium content of 0.032% and a nitrogen content of 0.0040%, yielding a titanium-to-nitrogen ratio of 8. *Id*. at 3:38-42.

Thus, Laurent discloses this element.

2. Motivation to Combine Cornette with Laurent

A PHOSITA would have combined Cornette and Laurent for the reasons stated in section X.B, incorporated here.

For claim 6 in particular, a PHOSITA would have understood that nitrogen is a common element in steels. Ex. 1043 at 14:37-15:3 (explaining that nitrogen "is a[n] element unavoidably included" in steels); Ex. 1035 at 4 (noting that nitrogen is a known impurity in steels); Ex. 1003 at ¶ 139. Thus, Cornette's silence as to nitrogen does not mean that nitrogen is absent from Cornette's boron steel—Usibor 1500.

Additionally, a PHOSITA would have recognized that mechanical properties of the base steel (*e.g.*, hardenability) can be adversely affected by the presence of nitrogen. *See*, *e.g.*, Ex. 1032 at ¶¶ 0092, 93 (explaining boron is an important element for the hardenability and that titanium is added to a boron steel "to bind all N so that B can fully fulfil its role. **Otherwise part of the B can be bound into BN with a loss in hardenability as a consequence**"); Ex. 1003 at ¶ 140. Indeed, boron is added to harden the steel, and excess nitrogen will, in essence, consume

the boron, thereby neutralizing any intended benefits of adding the boron to steel. *Id*.

Knowing the above, and in light of Cornette's failure to discuss nitrogen, a PHOSITA wanting to make a coated stamped product from a boron steel, as described by Cornette, would have been motivated to look to another reference, such as Laurent, disclosing a ratio of titanium to nitrogen that maintains a base steel's integrity (*e.g.*, maintain hardenability). *Id*. at ¶ 141.

Thus, Cornette in view of Laurent renders claim 6 obvious.

D. <u>Claim 7</u>

1. Laurent Teaches This Limitation

Claim 7 depends from claim 1 and adds "wherein the aluminum or aluminum alloy pre-coating comprises from 8% to 11% silicon by weight, from 2% to 4% iron by weight, the remainder being aluminum and impurities inherent in processing." Cornette does not disclose percentages of the Al-Si coating's components.

Laurent, however, discloses this exact same aluminum alloy pre-coating, explaining that "[t]he steel sheet then is coated … **in an aluminum bath [] containing [] from 8% to 11% silicon and 2% to 4% iron**." Ex. 1008 at 3:8-11; claim 7 ("The coated steel sheet according to claim 1, wherein the aluminum or aluminum alloy coating comprises from 9% to 10% silicon by weight, from 2% to

3.5% iron by weight, the remainder being aluminum.”). Moreover, a PHOSITA would have recognized that Laurent’s aluminum bath would have impurities as a result of the processing. Ex. 1003 at ¶ 144 (citing Ex. 1010 as corroborating evidence). Such an understanding is confirmed by the ’683 patent itself, *e.g.*, claim 7 acknowledges that the claimed “**impurities**” are “**inherent**,” and the ’683 patent even discloses that impurities in the aluminum bath are “**unavoidable**.” *See* Ex. 1001 at 11:65-12:1, 14:23-25.

Thus, Laurent teaches this element.

2. Motivation to Combine Cornette with Laurent

A PHOSITA would have combined Cornette and Laurent for the reasons stated in section X.B, incorporated here.

For claim 7 in particular, Cornette does not disclose specific percentages of the Al-Si coating’s components. Rather, Cornette describes the coating at a high-level, namely stating that the coating is “made of aluminum and silicon” and “is applied with a hot dipped process.” Ex. 1004 at 9. Accordingly, a PHOSITA wanting to make a coated steel stamped product, as described by Cornette, would thus be motivated to look to another reference, such as Laurent, disclosing additional details about aluminum-silicon coatings. Ex. 1003 at ¶ 147. Furthermore, because Laurent’s coating includes aluminum and silicon, a PHOSITA would have expected the proposed combination of Cornette and Laurent

to yield predictable and successful results (*e.g.*, a coated steel stamped product having the advantages as described by Cornette). *Id*.

As such, Cornette in view of Laurent renders claim 7 obvious.

E. <u>Claim 10</u>

1. Laurent Teaches This Limitation

Claim 10 depends on claim 1 and adds "wherein the product includes a **full martensitic structure**." Cornette discloses that its hot-stamped steel product can achieve a tensile strength of at least 1500 MPa, and knowing this, a PHOSITA would have understood that such a steel would have a full martensitic structure. Ex. 1004 at 10 (explaining that the coated stamped steel product after heat treatment has an ultimate tensile strength (UTS) of 1510 MPa); Ex. 1003 at ¶ 150. Nevertheless, Cornette lacks explicit disclosure of a full martensitic structure.

Laurent, however, provides explicit disclosure of this limitation, explaining that "[f]or a **completely martensitic structure** and for a steel having the composition of the example, the speed of cooling should be in excess of the critical speed of hardening which is 27° C./s for an austenitizing at 900° C. for 5 min." Ex. 1008 at 4:4-9.

Thus, Laurent teaches this element.

2. Motivation to Combine Cornette with Laurent

A PHOSITA would have combined Cornette and Laurent for the reasons stated in section X.B, incorporated here.

For claim 10 in particular, a PHOSITA would have understood that high strength steels are desired in certain applications (*e.g.*, steel products used as structural and safety components in automobiles), which Laurent teaches is achieved with a martensitic structure. Ex. 1003 at ¶ 154. Laurent also provides a recipe for achieving a completely martensitic structure (*e.g.*, the speed of cooling should be in excess of the critical speed of hardening, which is 27° C./s for an austenitizing at 900° C. for 5 minutes). Ex. 1008 at 4:4-9; *cf.* Ex. 1004 at 10 (explaining that a UTS of 1500 MPa was achieved "after austenitization at 900°C [for] 5 minutes"). Therefore, a PHOSITA wanting to make a coated stamped product from a boron steel, as described by Cornette, would have been motivated to look to another reference, such as Laurent, disclosing how to maximize certain mechanical properties of the boron steel, *e.g.*, by creating a fully martensitic structure. Ex. 1003 at ¶ 154.

Petitioner notes that Cornette does discuss martensite for **TRIP steels**. *See* Ex. 1004 at 4 (noting that martensite in steel leads to high tensile strength). Therefore, in view of Cornette's discussion about TRIP steels, a PHOSITA would have understood that tensile strength and martensite formation are intertwined, thus another reason a PHOSITA would have been motivated to look to another reference, such as Laurent, disclosing how to create a fully martensitic structure in **boron steels**, *e.g.*, to maximize tensile strength. Ex. 1003 at ¶ 155.

As such, Cornette in view of Laurent renders claim 10 obvious.

XI. GROUND #4: CORNETTE IN VIEW OF LAURENT, EP LAURENT, AND FR LAURENT RENDERS OBVIOUS DEPENDENT CLAIM 11

A. Cornette, Laurent, EP Laurent, and FR Laurent Teach This Limitation

Claim 11 depends from claim 1 and adds "wherein said layer (a) has a thickness less than 10 micrometers." Per section IX.B, incorporated here, Cornette renders claim 11 obvious. Claim 11 is also rendered obvious by Cornette in view of Laurent, EP Laurent, and FR Laurent.

As discussed earlier (*see supra* § IX.B), **Cornette** discloses a boron steel coated with a **25 µm** thick aluminum alloy pre-coating whereby the coating, after heat treatment, is approximately 40 µm thick and has an "Interdiffusion layer" that is *very close* to **10 µm thick**. **Laurent** discloses a boron steel that "is coated with an aluminum-based layer about **20 µm** in thickness." Ex. 1008 at 3:38-43. Likewise, **EP Laurent** discloses a boron steel coated with an aluminum alloy pre-coating, but, notably, EP Laurent's pre-coating has a thickness between "5 µm to 100 µm, **preferably between 10 µm and 25 µm**." *See* Ex. 1012 at ¶ 0011.

Accordingly, a PHOSITA would have recognized that reducing a thickness of Cornette's pre-coating (*e.g.*, from 25 µm to 24.5, 24, 23.5, 23, etc.) would decrease a thickness of the resulting coating, and, in turn, the thicknesses of the respective phases/layers shown in Cornette's Figure 22, including Cornette's

"Interdiffusion layer." Ex. 1003 at ¶ 159. In other words, using Cornette's same heat treatment while modifying Cornette to use a slightly thinner pre-coating, as taught by Laurent and EP Laurent, would lead to a multiphase alloy layer having an "Interdiffusion layer" that is less than 10 μm thick. *Id*.

Additionally, Cornette's multiphase alloy layer "is typically about 40 μm at the steel surface" after heat treatment when the pre-coating has a thickness of 25 μm. Ex. 1004 at 9. Thus, Cornette's 25 μm thick pre-coating experiences a greater than 50% increase in thickness due to the heat treatment (*e.g.*, heating at 900°C for five minutes). Ex. 1004 at 10. Similar to Cornette's pre-coating, FR Laurent's aluminum alloy pre-coating experiences a 50% increase in thickness due to the heat treatment. *See* Ex. 1010 at 5 (disclosing that the heat treatment involves heating at a temperature between 850°C and 950°C for six minutes and that "[b]y interdiffusion, the alloying leads to an increase of the thickness of the [pre-coating] which, for the treatment specified above, **corresponds to a 50% increase**"). Thus, in both Cornette and FR Laurent, the aluminum alloy pre-coating experiences at least a 50% increase in thickness as a result of heat treatment. Further, as shown above, the heat treatments described by Cornette and FR Laurent are similar, indicating that a 50% increase in coating thickness can be expected when using said heat treatments. Therefore, a pre-coating as thin as 20 μm (as taught by Laurent and EP Laurent) will still lead to an overall thickness of the

coated layer being greater than 30 μm after processing, which would undoubtedly have a first/interdiffusion layer of less than 10 μm, thereby meeting the thickness limitations of claims 1 and 11. Ex. 1003 at ¶ 160.

In sum, a PHOSITA would have recognized that modifying Cornette to have a slightly thinner pre-coating (less than 25 μm, as taught by Laurent (20 μm) and EP Laurent (10-25 μm)) would lead to a coating after heat treatment having: (i) thinner phases/layers, including a thinner "Interdiffusion layer" (*e.g.*, less than 10 μm thick), and (ii) an overall thickness that remains greater than 30 μm, due to the expected 50% increase in coating thickness (as taught by Cornette and FR Laurent). *Id*. at ¶ 161.

B. <u>Motivation to Combine Cornette with Laurent, EP Laurent, and FR Laurent</u>

A PHOSITA would have combined Cornette, Laurent, EP Laurent, and FR Laurent for reasons analogous to those stated in section X.B, incorporated here, as to Laurent. Indeed, EP Laurent and FR Laurent both describe pre-coated boron steels that are hot stamped and virtually identical to Laurent's steel. *Compare* Ex. 1008 at 3:38-43 *with* Ex. 1012 at ¶ 0019 and Ex. 1010 at 5.

Also, and in addition to these references each being directed to the same field of endeavor (*i.e.*, coated steel stamped products), the aluminum alloy pre-coatings disclosed by EP Laurent and FR Laurent are identical to Laurent's aluminum alloy pre-coating. *See, e.g.*, 1012 at ¶ 0011 (coating composed of "Si:

9% to 10%; Fe: 2% to 3.5%; Balance: Al and impurities"); Ex. 1010 at claim 6 (same); Ex. 1008 at 3:9-14 (same). Thus, the reasons stated in section X.B, as to Laurent, apply equally to EP Laurent and FR Laurent. Ex. 1003 at ¶ 163.

For claim 11 in particular, reducing a thickness of the aluminum alloy pre-coating, and in turn the interdiffusion layer, would have been **obvious to try** because there are a limited number of coating thicknesses discussed in EP Laurent (10-25 μm). *Id*. at ¶ 164. Further, reducing a thickness of the coating by 5 μm (or even 3 μm) would result in a substantial cost saving as less material is used on each part (*e.g.*, especially when thousands of coated parts are manufactured). *Id*. Because of this, a PHOSITA would have been motivated to reduce the pre-coating thickness in order to save costs. *Id*. In addition, because an automobile's overall weight impacts fuel economy, a PHOSITA would have been motivated to perform routine experimentation using reduced coating thicknesses in order to reduce weight and cost. *Id*.

Lastly, modifying Cornette to have a slightly thinner pre-coating is not a drastic modification. Rather, such a modification is routine and a PHOSITA would have thus had a reasonable expectation of success in making the proposed modification. *Id*. at ¶ 165.

As such, Cornette in view of Laurent, EP Laurent, and FR Laurent renders claim 11 obvious. *See id*. at ¶ 167.

XII. GROUND #5: CORNETTE IN VIEW OF NISHIBATA RENDERS OBVIOUS DEPENDENT CLAIM 5

A. Nishibata Teaches This Limitation

Claim 5 depends from claim 1 and adds "wherein the base steel comprises **20 ppm or less of sulfur**." As shown in Cornette's Table III, Usibor 1500 has a sulfur content up to 0.008%, which converts to 80 ppm (*i.e.*, ≤80 ppm). Ex. 1004 at 9; Ex. 1003 at ¶ 168, n. 7. Cornette does not provide explicit disclosure of "20 ppm or less."

Nishibata, however, describes several working examples of the steel sheets, which are summarized in the table below.

Table 1

Steel No.	Chemical composition (mass %; remainder: essentially Fe)														
	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Ti	Nb	Al	B	N
1	0.16	0.02	1.36	0.019	0.004	0.01	0.01	0.19	–	0.01	0.03	–	0.06	0.0013	0.008
2	0.21	0.25	1.20	0.008	0.002	0.01	0.02	0.20	–	0.01	0.02	0.01	0.05	0.0007	0.005
3	0.33	0.11	1.53	0.001	0.001	–	–	0.20	–	–	0.02	–	0.04	0.0015	0.001
4	0.42	0.11	1.51	0.001	0.001	–	–	0.20	0.01	–	0.02	–	0.04	0.0014	0.001

Ex. 1007 at Table 1.

As shown above in Table 1, Steel No. 2 has a sulfur content of 20 ppm.[9]

Thus, Nishibata discloses claim 5.

B. Motivation to Combine Cornette with Nishibata

There are many reasons why a PHOSITA would have looked to other

[9] Steel No. 2 also satisfies the elements for claims 3, 4, and 6.

references, such as Nishibata, and would have been motivated to modify Cornette based on the teachings of those references. *First*, Cornette and Nishibata are in the same field of endeavor as the '683 patent (*i.e.*, pre-coated boron steels used for automotive parts). *See* Ex. 1007 at 2 (disclosing "[t]his invention provides hot-formed members which can be produced from high-strength steel plates by using a hot-forming method and which also have stabilized strengths and toughnesses, as well as a hot-forming method for producing them"). Ex. 1003 at ¶ 173.

Second, a PHOSITA would have recognized that mechanical properties of a steel can be improved by reducing the steel's sulfur content as much as possible. *See*, *e.g.*, Ex. 1032 at ¶ 0088 (explaining that the sulfur content in a boron steel "has to be limited because a too high inclusion level **can deteriorate the *formability***" of the steel); Ex. 1003 at ¶ 174 (citing Ex. 1043 as corroborating evidence). In other words, sulfur is a recognized impurity in steels and reducing the sulfur content is preferred. *See* Ex. 1035 at 5 (confirming that sulfur is an impurity found in steels and that, ideally, sulfur would be limited to 10 ppm in steels by 1990); Ex. 1003 at ¶ 174. Knowing this, a PHOSITA would have been motivated to look for a boron steel having the lowest possible sulfur content, such as the boron steels described in Nishibata (*e.g.*, boron steels with low sulfur contents, *e.g.*, ≤20 ppm). *Id*.

Third, the values disclosed by Nishibata for Steel No. 2 substantially match

Cornette's acceptable ranges from Table III (*e.g.*, only slight mismatch with boron). Notably, Cornette states that the acceptable range for sulfur **is below 80 ppm**. Ex. 1004 at 9. In light of this, a PHOSITA would have expected the proposed combination of Cornette and Nishibata to yield predictable and successful results (*e.g.*, a coated steel stamped product having the advantages as described by Cornette and Nishibata). Ex. 1003 at ¶ 175.

Moreover, a PHOSITA would have been motivated to use one or more of the specific values disclosed by Nishibata to minimize experimenting with the ranges disclosed by Cornette. For example, a PHOSITA would have been motivated to use (i) the specific values for Nishibata's Steel No. 2 (*e.g.*, carbon, manganese, silicon, **sulfur**, etc.) that fall within Cornette's acceptable ranges from Table III or (ii) the specific value for sulfur alone. *Id*. at ¶ 176. Either way, a PHOSITA would have reduced his or her time experimenting with the ranges disclosed by Cornette. *Id*. Indeed, even as far back as 1983, steel makers were producing steels with sulfur contents around 20 ppm, with the percentage predicted to drop to 10 ppm by 1990, well before the Alleged Priority Date. Ex. 1035 at 4; Ex. 1003 at ¶ 176.

Thus, Cornette in view of Nishibata renders claim 5 obvious.

XIII. GROUND #6: CORNETTE IN VIEW OF SOMANI RENDERS OBVIOUS DEPENDENT CLAIM 9

A. Somani Teaches This Limitation

Claim 9 depends from claim 1 and adds "wherein the product is hot formed with a strain higher than 10% and cooled with a cooling rate higher than 50° C./s."

Petitioner submits that claim 9 is a "product-by-process" claim. *See SmithKline Beecham Corp. v. Apotex Corp.*, 439 F.3d 1312, 1315 (Fed. Cir. 2006) ("A product-by-process claim is one in which the product is defined at least in part in terms of the method or process by which it is made.") (internal quotations omitted). With product-by-process claims, "[i]f the **product** in a product-by-process claim is the same as or obvious from a **product of the prior art**, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 697 (Fed. Cir. 1985) (citations omitted).

Because claim 9 is a product-by-process claim, the process is not entitled to patentable weight over and above the product claimed in claim 1, especially because claim 9 does not add any structure to the claimed coated steel stamped product of claim 1. Ex. 1003 at ¶ 180. To the extent that Patent Owner argues or the Board finds that claim 9 is entitled to patent weight, claim 9 is nonetheless rendered obvious by Cornette in view of Somani.

Somani provides a detailed account of how "hot compression and simultaneous or subsequent fast cooling" changes the microstructure of a boron

steel. Ex. 1005 at 362. According to Somani, "several variables, such as the **temperature** at the moment of **deformation**, the amount of **plastic strain** and the **cooling rate**, are of importance and need to be optimised and controlled" to achieve the high potential strength of a martensitic steel (*i.e.*, minimize ferrite formation). *Id.* at 366. As one example, Somani found that a "tiny fraction of ferrite is formed [] at a **cooling rate of 280°C/s** after a plastic **strain of 0.24** [*i.e.*, a strain of 24%]." *Id*. at 367; Ex. 1003 at ¶ 181.

Somani also notes that in hot-stamping processes, "[t]ypical **cooling rates of the order of 100°C/s** have been estimated." *Id*. at 366; 363 (Figures 3 and 4 showing strain values from 0 to 1 (*i.e.*, 0% to 100%) and cooling rates of 50°C/s derived from a temperature decrease between 900°C and approximately **400°C**, respectively); *cf*. Ex. 1001 at 7:54-56 (defining the "cooling rate…as the mean rate between the exit of the heated blank from the furnace, **down to 400° C**").

Thus, Somani teaches "a strain higher than 10%" (*e.g.*, 24%) and "a cooling rate higher than 50° C./s" (*e.g.*, 280° C/s). *See* Ex. 1003 at ¶¶ 182-183.

B. <u>Motivation to Combine Cornette with Somani</u>

There are many reasons why a PHOSITA would have looked to other references, such as Somani, and would have been motivated to modify Cornette based on such references. *First*, Cornette and Somani are in the same field of endeavor as the '683 patent (*i.e.*, boron steels that are hot formed and quenched).

See Ex. 1005 at 361 (explaining that "[s]imultaneous forming and quenching is a patented manufacturing process for high-strength steel sheets …, which are used in safety related structural components in **car body structures** for weight reduction, good structural stiffness and strength and enhanced safety"). Ex. 1003 at ¶ 184.

Second, Cornette's Figure 21 shows that the pre-coated boron steel undergoes "Hot Forming and Quenching" (*i.e.*, cooling in the die). Clearly, the "Hot Forming" would inherently impart strain (*i.e.*, forming strain/local strain) onto the pre-coated boron steel and the "Quenching" would inherently cool the pre-coated boron steel at some rate. However, Cornette does not disclose a specific strain value or cooling rate. Therefore, a PHOSITA wanting to make a coated stamped product from a boron steel, as described by Cornette, would thus be motivated to look to another reference, such as Somani, disclosing strain values and cooling rates for boron steels. *Id*. at ¶ 185.

This is especially true as different stamped parts, *e.g.*, automotive components, will experience a wide range of strain situations, including some high-strain situations (*e.g.*, a complex part with high local strains versus a simple part with low local strains). *Id* at ¶ 186. Because of this, a PHOSITA would have understood that cooling rate is not necessarily "one size fits all," but rather, it varies depending on the composition of the alloy and the strain level, as disclosed by Somani. *See* Ex. 1005 at 363 (Figure 4 showing that, with a cooling rate of

50°C/s, volume fraction of ferrite changes based on a magnitude of plastic strain); Ex. 1003 at ¶ 186. Therefore, depending on the complexity (or lack thereof) of a stamped part, a PHOSITA would have been motivated to look to another reference, such as Somani, disclosing cooling rates for different strain situations. *Id.*

Third, a PHOSITA would have also been motivated to determine strain values and cooling rates to ensure that the resulting stamped steel part has sufficient mechanical properties, as described by Somani (*e.g.*, minimize ferrite formation while maximizing martensite formation). Ex. 1003 at ¶ 188. Indeed, Cornette's pre-coated boron steel is called **Usibor *1500*** for a reason, *i.e.*, the steel *can* exhibit an ultimate tensile strength of at least 1500 MPa. *Id*. Knowing this, a PHOSITA would have searched for processing parameters (*e.g.*, strain values and cooling rates) known to maximize martensite formation, as described by Somani, to ensure that a coated steel stamped product achieves its full potential—1500 MPa. *Id*.

Fourth, the specific values of Somani's boron steel substantially match Cornette's acceptable ranges from Table III. *Cf*. Ex. 1004 at 9 (listing ranges in Table III) *with* Ex. 1005 at 362 (listing values for "Docol" steel). In light of this, a PHOSITA would have expected the proposed combination of Cornette and Somani to yield predictable and successful results (*e.g.*, a coated steel stamped product having the advantages as described by Cornette and Somani). Ex. 1003 at ¶ 189;

see Ex. 1004 at 10 (noting that the "Al-Si coating does not significantly alter the heating process (heating speed temperature, dwell time) before forming nor the quenching speed in cooled tools"). In view of the overlap between Cornette's and Somani's boron steels, a PHOSITA would have had a reasonable expectation of success in making the proposed modification. Ex. 1003 at ¶ 189.

Thus, Cornette in view of Somani renders claim 9 obvious.

XIV. GROUND #7: CORNETTE IN VIEW OF ENGELS RENDERS OBVIOUS DEPENDENT CLAIM 11

A. Engels Teaches This Limitation

Claim 11 depends from claim 1 and adds "wherein said layer (a) has a thickness less than 10 micrometers." Per section IX.B, incorporated here, Cornette renders claim 11 obvious. Claim 11 is also rendered obvious by Cornette in view of Engels.

Engels discloses a boron steel (*e.g.*, 22MnB5, the same steel discussed in the '683 patent) coated with an aluminum alloy pre-coating whereby the coating (dubbed the "diffusion layer" in Engels) after heat treatment is approximately 40 μm thick. *See generally* Ex. 1041 at 135-42 (disclosing a hot-dipped aluminum coated boron steel having a multiphase diffusion layer, shown in Figure 5); Ex. 1003 at ¶ 192, n. 9.

phase number	layer thickness, µm	Al	Fe	Si	Cr	Mn
		Volume-%				
1	5 – 9	7,2	89,2	1,9	0,3	1,4
2	< 1µm	unmeasurable				
3	11 – 18	51,4	45,9	1,9	0,1	0,7
4	3 – 8	33,9	54,3	10,6	0,3	0,9
5	5 - 11	53,2	44,1	1,9	0,2	0,6

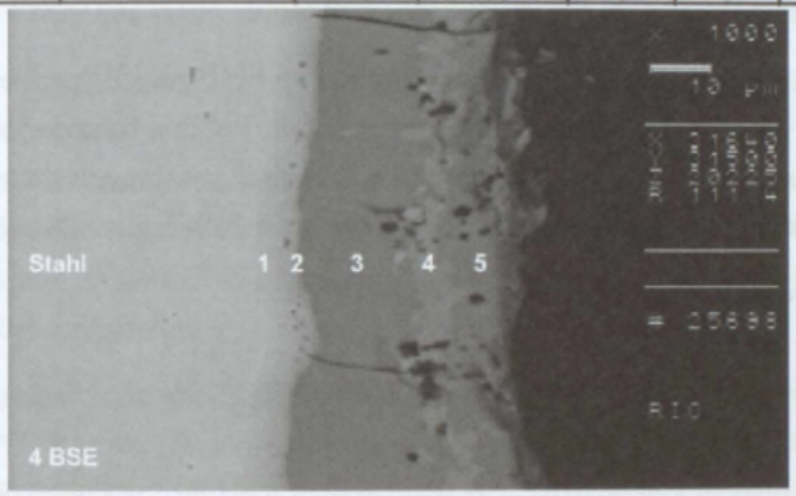


Figure 5. SEM micrograph of a cross-section polish of the diffusion layer

Engels, Ex. 1041, Figure 5

As shown above, Engels' "Figure 5 shows a cross-section polish of the ***diffusion layer*** of a **hot-dip *aluminum* coated *boron steel***." Ex. 1041 at 143. Engels' Figure 5 also includes a corresponding thickness for each phase/layer of the diffusion layer. Notably (as indicated by red box), the phase of the diffusion layer adjacent to the base steel (*i.e.*, the "Interdiffusion layer") **has a minimum thickness of *5 µm* and a maximum thickness that is close to, but less than, *10 µm*** (*e.g.*, phases 1 and 2 are deemed to compose the same sub-layer, just like in the '683 patent, *see* Ex. 1001 at 12:61-63). Also, phase 1 of the diffusion layer includes elements from the base steel (namely Fe, Cr, and Mn), demonstrating that

"intermingling of the molecules of two or more substances" occurred in phase 1. *See supra* § VII.B, incorporated here, construing "Interdiffusion layer"); Ex. 1003 at ¶ 193.

As such, Engels discloses this element.

B. Motivation to Combine Cornette with Engels

There are many reasons why a PHOSITA would have looked to other references, such as Engels, and would have been motivated to modify Cornette based on such references. *First*, Cornette and Engels are in the same field of endeavor as the '683 patent (*i.e.*, pre-coated boron steels used for automotive parts). *See* Ex. 1041 at 135 (disclosing that "hot-stamping of boron-alloyed steels (22MnB5) is used to produce the components," such as "A and B-pillar reinforcements" of automobiles). Ex. 1003 at ¶ 195.

Second, a PHOSITA would have understood that Cornette and Engels could be combined by known methods to yield predictable results. For example, a PHOSITA would have recognized that minor tweaks (*i.e.*, routine experimentation) to Cornette's processing parameters would cause changes to the resulting coating (*i.e.*, Cornette's "multiphase alloy layer"), including changes to the interdiffusion layer's thickness. *Id*. at ¶ 196 (citing Ex. 1043 as corroborating evidence). Indeed, Engels explains that the "diffusion process is affected by the **preset temperature profile** of the heating facility," and the temperature profile is set based on several

processing parameters, including **heating rate**, **total processing time**, maximum austenitizing **temperature**, and material thickness. Ex. 1041 at 142.

Moreover, the proposed modification to Cornette is not dramatic, rather, it involves reducing a thickness (*e.g.*, by a few microns) of a *single* phase/layer of Cornette's multiphase alloy layer. Such a modification could be achieved through routine experimentation (*e.g.*, adjusting the processing parameters known to affect the diffusion process, as discussed in Engels). Ex. 1003 at ¶ 197. Because of this, a PHOSITA would have had a reasonable expectation of success in making the proposed modification. *Id*.

Third, Cornette does not disclose specific thickness *values* for each phase of the coating (*i.e.*, the multiphase alloy layer). Rather, Cornette's Figure 22 includes a scale bar for measuring phase thicknesses, which, as demonstrated earlier, can be used to accurately measure phase thicknesses. Nevertheless, a PHOSITA interested in phase thicknesses in a coated steel stamped product would be motivated to look to another reference disclosing specific thickness values for each phase of the coating, such as Engels, to reinforce what is shown and taught by Cornette. *Id*. at ¶ 198.

Fourth, Engels discloses that "[w]hen using hot-dip aluminum boron steels, it is crucial to look for [a] correctly shaped ***diffusion layer*** with regard to layer thickness, porosity and roughness" because "***this layer*** **will decisively impact the**

corrosion and welding properties of the hot stamped parts." Ex. 1041 at 142. Knowing this, a PHOSITA would have been motivated to substitute Engels' "diffusion layer" for Cornette's "multiphase alloy layer," in order to evaluate the corrosion and welding properties of the hot-stamped parts with Engels' "diffusion layer," as compared to the corrosion and welding properties of Cornette's hot-stamped products. *See* Ex. 1004 at 10 (disclosing corrosion and welding properties of Cornette's hot-stamped products); Ex. 1003 at ¶ 199.

Thus, Cornette in view of Engels renders claim 11 obvious.

XV. CONCLUSION

Trial should be instituted and the Challenged Claims should be cancelled as unpatentable.

Dated: June 28, 2019

Respectfully Submitted,

/ Dion M. Bregman /
Dion M. Bregman, Reg. No. 45,645

Listing of Claims from U.S. 9,708,683	
Claim 1	
Preamble	1. A coated steel stamped product, which comprises:
1[a]	(a) a strip of base steel having a first side and a second side; and
1[b]	(b) a coating on at least one of said first side of said strip of base steel and said second side of said strip of base steel,
1[c]	wherein: (i) said coating results from the interdiffusion between said base steel, and aluminum or aluminum alloy pre-coating, and (ii) wherein said coating comprises, proceeding from the base steel outwards: (a) an Interdiffusion layer, (b) an Intermediate layer, (c) an Intermetallic layer, and (d) a Superficial layer,
1[d]	wherein said coating has a thickness greater than 30 micrometers and
1[e]	wherein said layer (a) has a thickness less than 15 micrometers.
Claim 2	
Preamble	2. The coated steel stamped product according to claim 1,
2[a]	wherein the said layers (c) and (d) are quasi continuous by occupying at least 90% of a level corresponding to each said layer and
2[b]	wherein less than 10% of layer (c) is present at an extreme surface of the product.

Listing of Claims from U.S. 9,708,683	
Claim 3	
Preamble	3. The coated steel stamped product according to claim 1,
3[a]	wherein the steel in the strip comprises the following components by weight based on total weight: 0.15%<carbon<0.5%; 0.5%<manganese<3%; 0.1%<silicon<0.5%; 0.01%<chromium<1%; titanium<0.2%; aluminum<0.1%; phosphorus<0.1%; sulfur<0.05%; 0.0005%<boron<0.08%; and
3[b]	further comprises iron and impurities inherent in processing.
Claim 4	
Preamble	4. A coated steel stamped product according to claim 1,
4[a]	wherein the steel in the strip comprises the following components by weight based on total weight: 0.20%<carbon<0.5%; 0.8%<manganese<1.5%; 0.1%<silicon<0.35%; 0.01%<chromium<1%; titanium<0.1%; aluminum<0.1%; phosphorus<0.05%; sulfur<0.03%; 0.0005%<boron<0.01%; and
4[b]	further comprises iron and impurities inherent in processing.

Listing of Claims from U.S. 9,708,683	
Claim 5	
Preamble	5. The coated steel stamped product according to claim 1,
5[a]	wherein the base steel comprises 20 ppm or less of sulfur.
Claim 6	
Preamble	6. The coated steel stamped product according to claim 1,
6[a]	wherein the ratio of titanium to nitrogen in the base steel in weight % is in excess of 3.42.
Claim 7	
Preamble	7. The coated steel stamped product according to claim 1,
7[a]	wherein the aluminum or aluminum alloy pre-coating comprises from 8% to 11% silicon by weight, from 2% to 4% iron by weight, the remainder being aluminum and impurities inherent in processing.
Claim 8	
Preamble	8. A land motor vehicle comprising the heat treated coated steel product according to claim 1.
Claim 9	
Preamble	9. The coated steel stamped product according to claim 1,
9[a]	wherein the product is hot formed with a strain higher than 10% and cooled with a cooling rate higher than 50° C./s.
Claim 10	
Preamble	10. The coated steel stamped product according to claim 1,
10[a]	wherein the product includes a full martensitic structure.
Claim 11	
Preamble	11. The coated steel stamped product according to claim 1,
11[a]	wherein said layer (a) has a thickness less than 10 micrometers.

CERTIFICATION OF COMPLIANCE WITH TYPE-VOLUME LIMITS

This Petition includes 13,968 words, as counted by Microsoft Word, and is therefore in compliance with the 14,000 word limit established by 37 C.F.R. 42.24(a)(1)(i). Accordingly, pursuant to 37 C.F.R. 42.24(d), lead counsel for the Petitioner hereby certifies that this Petition complies with the type-volume limits established for a petition requesting IPR.

Dated: June 28, 2019

Respectfully Submitted,

/ Dion M. Bregman /
Dion M. Bregman, Reg. No. 45,645

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. 42.6(4) and 42.105, lead counsel for Petitioner hereby certifies that on June 28, 2019, copies of this Petition and all supporting exhibits were sent via Federal Express to the correspondence address of record for the ’683 patent:

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Dated: June 28, 2019

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