

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

DECLARATION OF DR. MICHAEL MILES

POSCO Exhibit 1003
Filed with Petition for IPR of U.S. Patent No. 9,708,683

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EXHIBIT LIST

<u>Exhibit</u>	<u>Description</u>
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	Reserved
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	Maresh 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	Vaissiere et al. " <i>Development of Pre-Coated Boron Steel for Applications on PSA Peugeot Citroën and RENAULT Bodies in White,</i> " SAE Technical Paper 2002-01-2048, 2002 ("Vaissiere")
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,” <i>Modelling and Simulation in Materials Science and Engineering</i> . 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”), <i>published in</i> 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, Michael P. Miles, hereby declare as follows:

I. ENGAGEMENT

1. I reside at 373 South 1200 East, Springville, UT 84663.
2. I have been retained by POSCO (“Petitioner”) in connection with the above-captioned petition for *Inter Partes* Review (“IPR”) of U.S. Patent No. 9,708,683 to Pascal Drillet et al. (“the ‘683 patent”). I understand the ‘683 patent is currently assigned to ArcelorMittal (“Patent Owner”).
3. I have been asked by Petitioner to offer opinions regarding the ‘683 patent, including the unpatentability of claims 1-11 (which I may refer to subsequently as the “Challenged Claims”) in view of certain prior art. This declaration sets forth the opinions I have reached to date regarding these matters.
4. I am being compensated by Petitioner at my standard hourly consulting rate for my time spent on this matter. My compensation is not contingent on the outcome of the IPR or on the substance of my opinions.
5. I have no financial interest in Petitioner or Patent Owner.

II. BACKGROUND

A. Educational Background

6. I earned a B.S. degree in Metallurgical Engineering in 1989 from the University of Idaho. I then earned my M.S. degree in Metallurgical Engineering in 1991 from the Ohio State University. I earned my Ph.D. degree in Materials Science and Engineering from Ecole des Mines de Paris in 1995. My M.S.

research was focused on the formability of sheet metal alloys, including several steel alloys, an aluminum alloy, and a brass alloy. My Ph.D. work involved the modeling of hot forming processes, especially forging, where the heat transfer between the tools and the workpiece were taken into account.

B. Career History & Relevant Industry Participation

7. I joined Brigham Young University (BYU), in Provo, UT, in 2001 as an assistant professor in the manufacturing engineering technology program. At BYU, I became an associate professor in 2007 and a full professor in 2013. I served as program chair of the manufacturing engineering technology program from 2009 – 2016. I am currently a professor in the manufacturing engineering department (there was a program change in 2019) at BYU. My research focus is on the forming and fabrication of metal alloys, with emphasis on microstructure/formability relationships and the welding/joining of dissimilar alloys.

8. I have been funded by the National Science Foundation six times on various research topics related to forming and joining of sheet metal alloys, including microstructure/formability relationships in steels containing retained austenite. I have also received funding from the Department of Energy (dissimilar metals joining) and NASA (friction stir welding of aluminum alloys). In all of these projects, I have mentored students in carrying out the research, collaborated

with companies and National Labs (General Motors, Honda, Megastir Technologies, Oak Ridge National Lab), and worked with these teams to publish our results in archival journals.

9. Prior to joining BYU, I worked as a project engineer from 1995 to 1996 at Pechiney Research Center in Voreppe, France. From 1996 to 1998, I was as a tooling engineer and a project engineer for American National Can (a subsidiary of Pechiney) in Elk Grove Village, Illinois. From 1998 to 1999, I was an engineering manager for American National Can in Whitehouse, Ohio, then assumed the role of assistant plant manager from 2000 to 2001 at the same facility for Rexam PLC (American National Can was purchased by Rexam).

10. I am an inventor listed in the following United States patents: End Closure with Improved Openability (6,024,239), Three-body joining using friction stir processing techniques (7,845,545), Friction bit joining using a friction rivet (9,764,375), in addition to two other applications that are in process. A listing of the year, patent number, and patent title is found in my curriculum vitae, included in Appendix A, below. I am also a listed inventor on several international patents.

11. Additional information regarding my background, qualifications, and presentations is included as part of my *curriculum vitae* (“CV”), which is attached as Appendix A.

12. It is for at least these reasons that I am an expert in sheet metal forming and the microstructure/property relationships that influence formability, including phase transformations that occur during the forming of advanced high strength sheet steels for automotive manufacturing.

III. MATERIALS REVIEWED

13. In forming my opinions, I have reviewed the '683 patent and considered each of the documents listed in the Exhibit List above and the other references cited in my declaration. In reaching my opinions, I have relied upon my experience in the field and also considered the viewpoint of a person of ordinary skill in the art at the time of the earliest claimed priority date of the '683 patent, *i.e.*, late 2006. As explained below, I am familiar with the level of skill of a person of ordinary skill in the art regarding the relevant technology at issue as of that time.

IV. DESCRIPTION OF THE RELEVANT TIMEFRAME, THE RELEVANT FIELD, AND A PERSON OF ORDINARY SKILL IN THE ART

14. I understand that the '683 patent claims priority to a National Stage Application of PCT/IB2006/004019 filed October 30, 2006 (which I will also refer to as the "Priority Date"). For the purposes of my analysis, and in the absence of any information to the contrary, I have used the October 30, 2006 date as the relevant date for my analysis of the prior art.

15. I considered several factors to determine the skill level of a person of ordinary skill in the art of the '683 patent in October 2006, including the types of problems encountered in the art, the solutions to those problems, the pace of innovation in the field, the sophistication of the technology, and the education level of active workers in the field.

16. Based on my knowledge, expertise, and the prior art cited in the '683 patent, it is my opinion that a person of ordinary skill in the field of the '683 patent 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.

17. Unless noted otherwise, when I state that something would be known or understood by one skilled in the art, or a skilled artisan, or a person having ordinary skill in the art ("PHOSITA"), I am referring to a person with this level of education and experience at the time of the alleged invention, which I am assuming to be in or around October 2006, based on the dates of the provisional applications to which the '683 patent claims priority.

V. OVERVIEW OF THE '683 PATENT

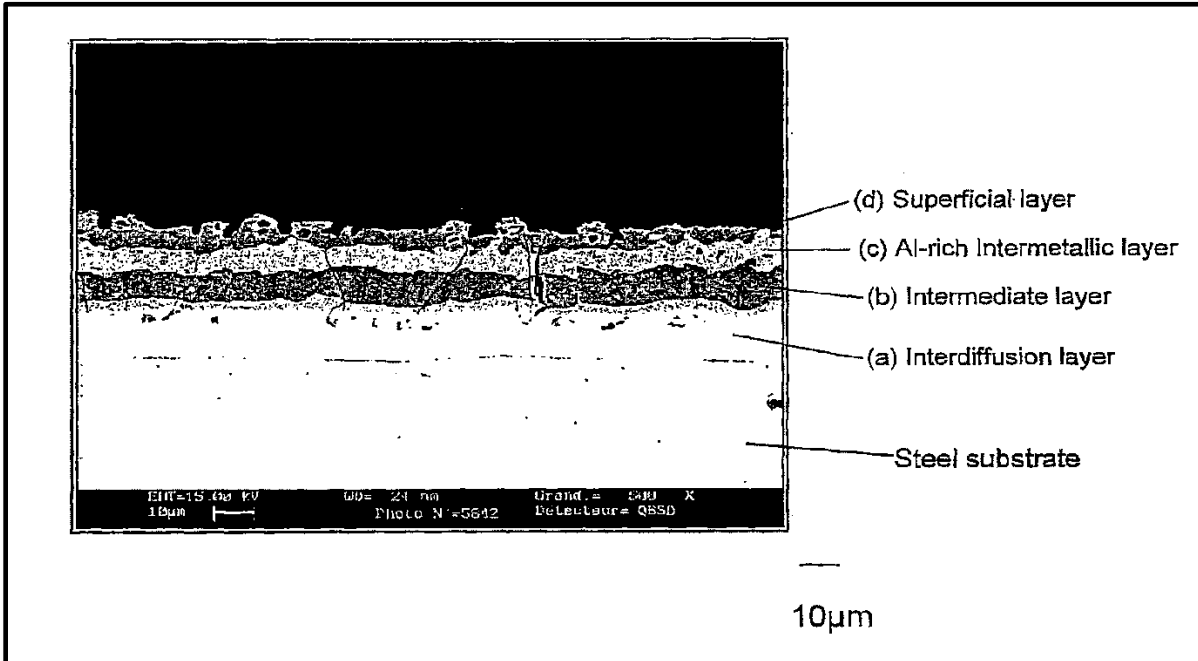
18. I have reviewed the '683 patent and understand that Pascal Drillet, Dominique Spehner, and Ronald Kefferstein are listed as the inventors.

19. A PHOSITA would have understood that the claims of the '683 patent are directed to a coated steel product prepared from a base steel with an aluminum (or aluminum alloy) pre-coating. Ex. 1001 at claim 1. A PHOSITA would have also understood that 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, as explained by the '683 patent. *Id.* at 6:14-22.

20. The '683 patent begins by acknowledging 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 even 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.

21. The '683 patent attempts to differentiate itself from the '805 patent by asserting 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, in my opinion. 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 15:21-30 (claiming a “coated steel stamped product” that comprises “a strip of base steel” and “a coating ... [that] results from the interdiffusion between said base steel, and [the] aluminum ... pre-coating”).



’683 patent, Ex. 1001, Figure 1

22. Figure 1 of the '683 patent, above, shows an example of the claimed coating. As shown, the coating is composed of a succession of coating layers starting at the steel substrate and including: (a) an interdiffusion layer; (b) an intermediate layer; (c) an intermetallic layer; and (d) a superficial layer. *Id.* at 6:22-30. According to the '683 patent, “particularly good weldability” is achieved with this succession of coating layers. *Id.*

23. I have reviewed the file history for the '683 patent (Ex. 1002). According to the file history, the Examiner did not consider some (*e.g.*, Cornette, Somani, Engels, FR Laurent) of the prior art that I discuss herein. I also note here that multiphase alloy layers, such as the one described by the '683 patent, were well-known long before the '683 patent's filing. *See* Ex. 1043 at 12:30-34 (explaining that it “is known that one to five phases can coexist in an alloyed aluminum-system plated layer depending on the deposit amount of plating, the steel composition, the heating conditions and the like”).

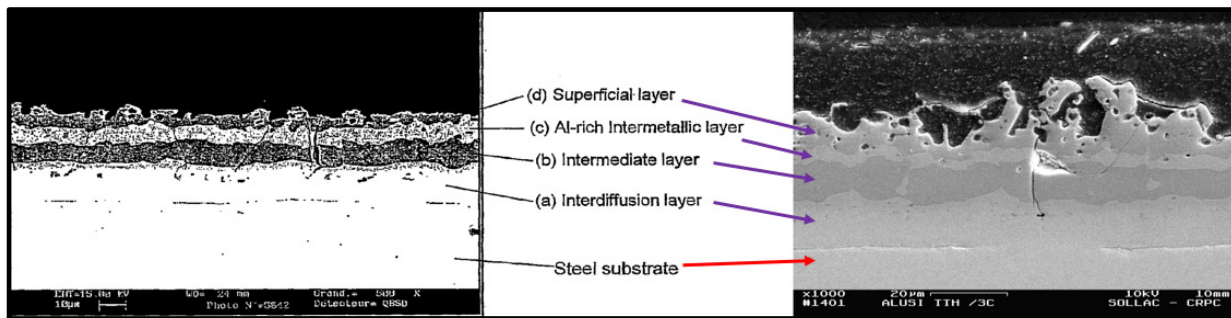
VI. OVERVIEW OF THE PRIOR ART

A. Cornette

24. I have reviewed the article “High Strength Steels For Automotive Safety Parts” authored by D. Cornette et. al. (hereinafter “Cornette” or “Ex. 1004”). I was able to obtain a copy of Cornette from the publisher's website at <https://www.sae.org/publications/technical-papers/content/2001-01-0078/>.

Cornette bears a copyright date of 2001, and the publisher's website indicates that Cornette was published on March 5, 2001 and also presented at the SAE 2001 World Congress. Thus, it is my understanding that Cornette was published in 2001 (especially because SAE is a well-known publisher in this field). I've also been told by Petitioner that Cornette qualifies as prior art to the '683 patent because it was publicly accessible before the Priority Date.

25. Cornette discloses a coated steel product prepared from a base steel with an aluminum alloy pre-coating. *See* Ex. 1004 at Abstract, 9-11 ("A specific part of the text deals with a ultra high tensile strength pre-coated boron steel for hot forming."). 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.").



'683 Patent, Ex. 1001, Fig. 1

Cornette, Ex. 1004, Fig. 22

26. 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. *See id.* at 9-10 (noting that Fig. 22 "shows a section view of the coating after heat treatment"). 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.* I note that 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 coating after heat treatment. Ex. 1001 at 12:5-15, 12:45-60.

27. I also note 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, Ex. 1033) and Cornette have common figures, likely because the two references have a common contributor: Jean-Pierre Laurent. With that said, 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”). Additionally, the resolution of Cornette’s Figure 22 is far higher than that of Vaissiere’s Figure 15, such that layer thickness and scale are readily apparent in Cornette’s Figure 22. Put another way, in my opinion, a PHOSITA may have struggled to obtain accurate measurements from Vaissiere’s Figure 15 due to the figure’s low resolution, but is easily able to obtain accurate measurements from Cornette’s Figure 22 due to the figure’s high quality (*i.e.*, high resolution). As such, Cornette and Vaissiere have material differences.

B. Somani

28. I have reviewed the article “Dimensional Changes and Microstructural Evolution in a B-bearing Steel in the Simulated Forming and Quenching Process” authored by M. Somani et. al. (hereinafter “Somani” or “Ex. 1005”). I was able to obtain a copy of Somani from the publisher’s website at https://www.jstage.jst.go.jp/article/isijinternational1989/41/4/41_4_361/_article/-char/en. Somani bears a copyright date of 2001, and the publisher’s website indicates that Somani was published on April 15, 2001. Thus, it is my understanding that Somani was published in 2001 (especially because ISIJ is a well-known publisher in this field). I’ve also been told by Petitioner that Somani qualifies as prior art to the ’683 patent because it was publicly accessible before the Priority Date.

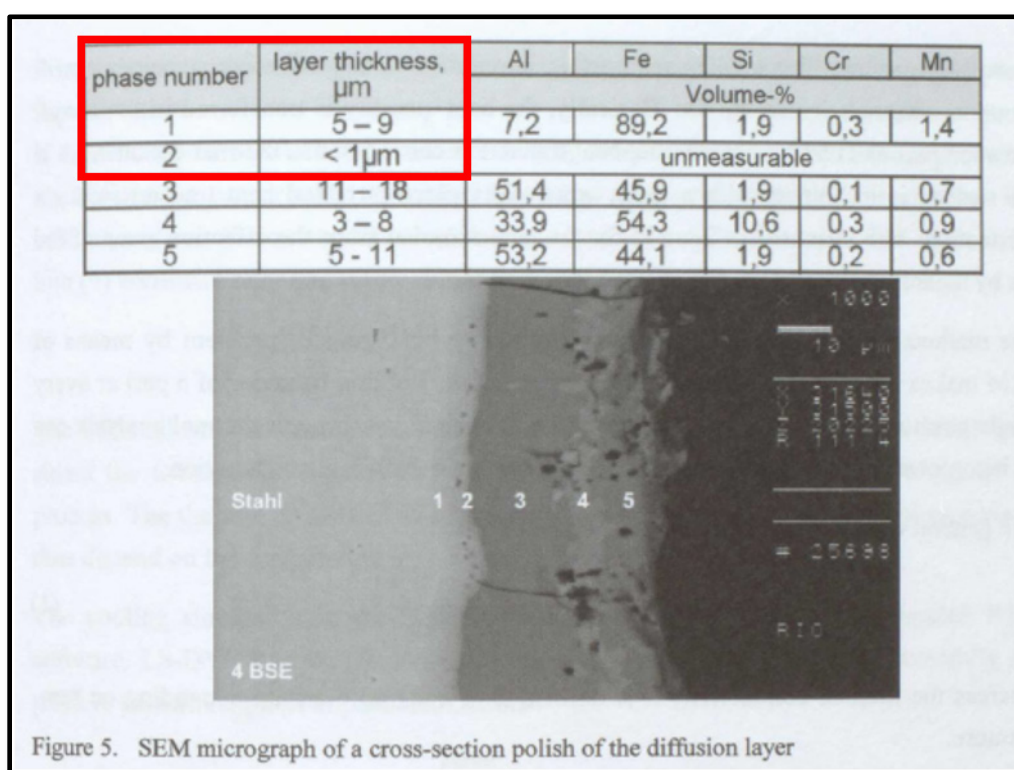
29. Somani is directed toward forming and quenching processes for boron steels. Ex. 1005 at Abstract, 361. Particularly, Somani provides a detailed account of how “hot compression and simultaneous or subsequent fast cooling” changes a microstructure of a boron steel. *Id.* at 362. Somani found that plastic 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.

C. Engels

30. I have reviewed the article “Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels” authored by H. Engels et. al. (hereinafter “Engels” or “Ex. 1041”). I was able to obtain a copy of Engels from Petitioner, which I understand was provided to Petitioner by the University of Stuttgart in Germany. Engels bears a copyright date of 2006, and the book in

which Engels appears (“New Developments in Sheet Metal Forming”) indicates that Engels was presented at a conference near Stuttgart Germany on May 9th and 10th, 2006. I have been told by Petitioner that Engels qualifies as prior art to the ’683 patent because it was publicly accessible before the Priority Date.

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



Engels, Ex. 1041, Figure 5

32. As shown in Figure 5, above, Engels’ diffusion layer is composed of a succession of coating layers starting at the steel substrate. *See* Ex. at 1044 (certifying that the term “Stahl” is a German word that translates to the English word “steel”). Notably, Engels’ Figure 5 demonstrates (i) that the diffusion layer

is approximately 40 μm thick and (ii) that a phase adjacent to the base steel has a thickness less than 10 μm .

D. Nishibata

33. I have reviewed WO Application Pub. No. 2004/106573 to Nishibata et al. (hereinafter “Nishibata” or “Ex. 1006”) published on December 9, 2004. I have been told by Petitioner that this reference qualifies as prior art to the ’683 patent. I understand that Ex. 1007 is a certified English translation of the Japanese language original, Ex. 1006.

34. Like Cornette, Nishibata discloses a coated steel stamped product prepared from a steel with an aluminum alloy pre-coating. *See* Ex. 1007 at 2 (“this invention provides hot-pressed members, including mechanical structural parts, such as automobile body structural parts, suspension parts”). Notably, Nishibata discloses boron steels having 20 ppm or less of sulfur (S) by weight. *Id.* at 10.

E. Laurent

35. I have reviewed U.S. Patent No. 6,296,805 to Laurent et al. (hereinafter “Laurent” or “Ex. 1008”) issued on October 2, 2001. I have been told by Petitioner that this reference qualifies as prior art to the ’683 patent.

36. Like Cornette, Laurent discloses a coated steel stamped product prepared from a base steel with an aluminum alloy pre-coating. *See* Ex. 1008 at 1:47-48; 2:46-50 (disclosing “a hot-rolled steel sheet, which then can be cold-

rolled [and] coated” and that allows for “a great variety of shaping, in particular a deep stamping”). Laurent also discloses compositions of boron steels and aluminum (or aluminum alloy) pre-coatings. *See id.* at 1:47-64; 2:40-45.

37. I understand that during prosecution, Laurent was cited by Patent Owner and applied by the Examiner as an anticipatory reference against claim 1 and several dependent claims. Here, however, I do not rely on Laurent to challenge claim 1. 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 Examiner, and (iv) there is minimal, if any, overlap between the arguments made during examination and the manner in which I rely on the prior art.

F. FR Laurent

38. I have reviewed French Application No. 2,833,504 to Laurent et al. (hereinafter “FR Laurent” or “Ex. 1009”) published on June 20, 2003. I have been told by Petitioner that this reference qualifies as prior art to the ’683 patent. I

understand that Ex. 1010 is a certified English translation of the French language original, Ex. 1009.

G. EP Laurent

39. I have reviewed European Application Pub. No. 1,013,785 to Laurent et al. (hereinafter “EP Laurent” or “Ex. 1011”) published on June 28, 2000. I have been told by Petitioner that this reference qualifies as prior art to the ’683 patent. I understand that Ex. 1011 is a certified English translation of the French language original, Ex. 1012.

40. FR Laurent and EP Laurent are similar to Laurent but they also include several important differences, including: (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.

VII. ANTICIPATION

41. I have been instructed as to the definition of “anticipation” in the context of the patent laws. I understand that for a claim to be invalid as anticipated, all of the requirements of that claim must be present in a single previous device/system or method that was known of, used, or described in a single

previous printed publication or patent. To anticipate the invention, the prior art does not have to use the same words as the claim, but all of the requirements of the claim must have been disclosed, either stated expressly or implied to a person having ordinary skill in the art in the technology of the invention, so that looking at that one reference, that person could make and use the claimed invention.

VIII. OBVIOUSNESS

42. I have been instructed as to the definition of “obviousness” in the context of the patent laws.

43. It is my understanding that even though an invention may not have been identically disclosed or described before it was made by an inventor, in order to be patentable, the invention must also not have been obvious to a PHOSITA before the date of the alleged invention (which in these proceedings I am assuming to be October 30, 2006).

44. I understand that obviousness is a question of law based on underlying factual issues including the level of ordinary skill in the art at the time of the patent’s alleged invention, the scope and content of the prior art, and any differences between the prior art and the claimed invention.

45. I understand that the scope and content of prior art for deciding whether the invention was obvious includes at least prior art in the same field as the claimed invention. It also includes prior art from different fields that a

PHOSITA would have considered when trying to solve the problem that is addressed by the invention.

46. I understand that the existence of each and every element of the claimed invention in the prior art does not necessarily prove obviousness. Most, if not all, inventions rely on building blocks of prior art. But, in considering whether a claimed invention is obvious, I understand that one may find obviousness if, at the time of the patent's alleged invention, there was a reason that would have prompted a PHOSITA to combine the known elements in a way the claimed invention does, taking into account such factors as (1) whether the claimed invention was merely the predictable result of using prior art elements according to their known function(s); (2) whether the claimed invention provides an obvious solution to a known problem in the relevant field; (3) whether the prior art teaches or suggests the desirability of combining elements claimed in the invention; (4) whether the prior art teaches away from combining elements in the claimed invention; (5) whether it would have been obvious to try the combinations of elements, such as when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions; and (6) whether the change resulted more from design incentives or other market forces.

47. To find that the prior art renders the invention obvious, I understand that one must find that the prior art provided a reasonable expectation of success. I also understand that it is impermissible to find obviousness based on hindsight reasoning, *i.e.*, only considering what was known at the time of the patent's alleged invention.

IX. SUMMARY OF MY OPINIONS

48. Having reviewed the '683 patent and the prior art cited above, I have formed the following opinions:

- independent claim 1 and dependent claim 2 are anticipated by Cornette;
- dependent claims 8 and 11 are rendered obvious over Cornette;
- dependent claims 3-4, 6-7, 10 are rendered obvious over Cornette in view of Laurent;
- dependent claim 11 is rendered obvious over Cornette in view of Laurent, EP Laurent, and FR Laurent;
- dependent claim 5 is rendered obvious over Cornette in view of Nishibata;
- dependent claim 9 is rendered obvious over Cornette in view of Somani; and

- dependent claim 11 is rendered obvious over Cornette in view of Engels.

The reasons for my opinions are discussed in further detail below.

X. CLAIM CONSTRUCTION

49. Below are a number of claim terms whose meaning is unclear. As such, I have provided the following proposed meanings for these terms.

A. “interdiffusion” (Claim 1)

50. This term appears in claim 1. For example, claim 1 recites “said coating results from the interdiffusion between said base steel, and aluminum or aluminum alloy pre-coating.” To my knowledge, this term has no well understood meaning in the art, and the ’683 patent fails to mention or define the term “interdiffusion.” Therefore, the term needs to be given a meaning.

51. The term “interdiffusion,” in my opinion, is a combination of the parts “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 *interflow*, *interchange*”); 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 time 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”).

52. I note that the '683 patent's discussion of “diffusion” aligns with the dictionary definitions provided above. For example, the '683 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; *see also* Ex. 1033 at 5 (explaining that “[h]eating the pre-coated USIBOR 1500 at the required temperature creates an alloying reaction by iron diffusion from the steel to the coating. The result is the formation of a multiphase Fe-Al-Si layer”).

53. 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.” *Id.* 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 I was unable to find a definition for “alliation” in English dictionaries, it is my understanding that the term “alliation” is a French¹ word that translates to the English word “alloying.” *See* Ex. 1031

¹ Listed inventors are French citizens.

(certifying that the French word “alliation” translates to the English word “alloying”). As such, in my opinion, 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. *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”).

54. Therefore, in my opinion, 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.

B. “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*”

55. 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, in my opinion, a PHOSITA would give these terms their plain and ordinary meaning, which I provide below.

1. “Interdiffusion layer” (Claim 1)

56. Per my discussion in section X.A, a PHOSITA would have understood that the term “interdiffusion” means “intermingling of the 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”).

57. As such, in my opinion, 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.”

2. “Intermediate layer” (Claim 1)

58. While the '683 patent fails to define the term “intermediate,” it too 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.”).

59. As such, in my opinion, a PHOSITA would have understood “Intermediate layer” to mean “a layer between two other layers.”

3. “Intermetallic layer” (Claim 1)

60. While the ’683 patent fails to define the term “intermetallic,” it again 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”).

61. As such, in my opinion, 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.”

4. “Superficial layer” (Claim 1)

62. While the ’683 patent fails to define the term “superficial,” it too has a plain and ordinary meaning. *See* Ex. 1026 at 1828 (defining “superficial” as “lying on or pertaining to the superficies or surface”); Ex. 1027 at 1908 (defining “superficial” as “being at, on, or near the surface”).

63. As such, in my opinion, a PHOSITA would have understood “Superficial layer” to mean “a surface layer.”

XI. THE CHALLENGED CLAIMS ARE INVALID

A. Ground #1: Cornette anticipates independent claim 1 and dependent claim 2

64. For the reasons I set forth below, in my opinion, at least independent claim 1 and dependent claim 2 are anticipated by Cornette.

1. Claim 1

65. Claim 1 of the '683 patent recites the following limitations (each of which are addressed in my analysis below):

[p] A coated steel stamped product, which comprises:

[a] a strip of base steel having a first side and a second side;

[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,

[c] wherein:

said coating results from the interdiffusion between said base steel, and aluminum or aluminum alloy pre-coating, and

[d] wherein said coating comprises, proceeding from the base steel outwards:

an Interdiffusion layer,

an Intermediate layer,

an Intermetallic layer, and

a Superficial layer,

[e] wherein said coating has a thickness greater than 30 micrometers and

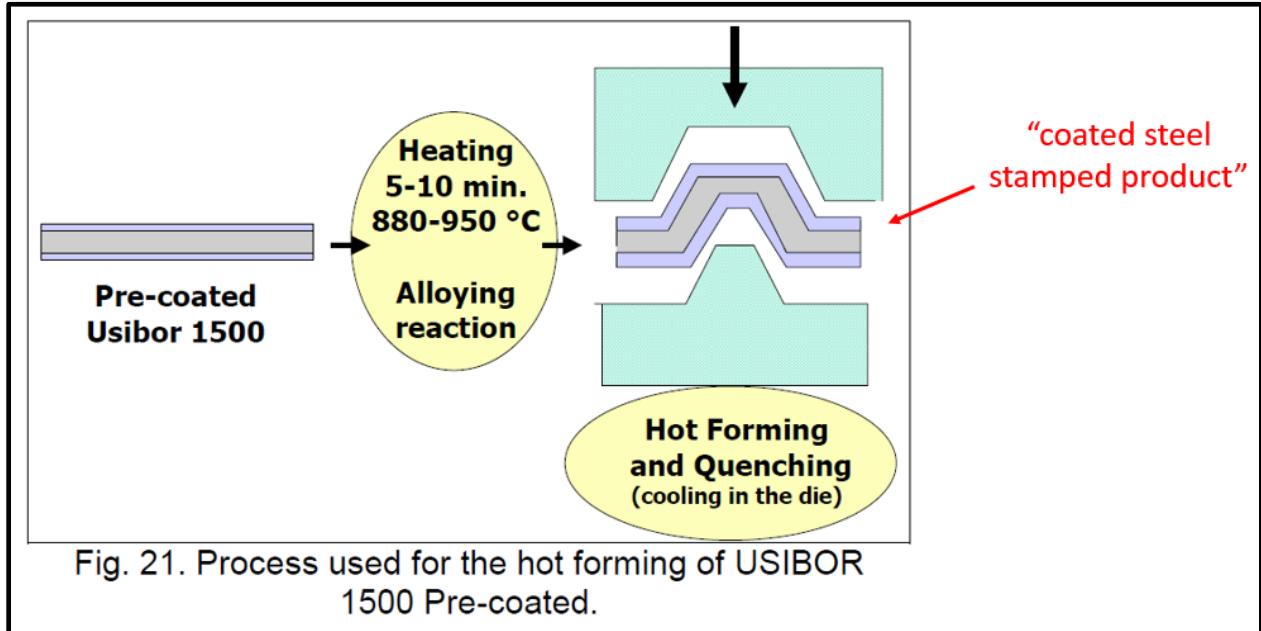
[f] wherein said layer (a) has a thickness less than 15 micrometers.

p. “A coated steel stamped product, which comprises:”

66. I have been informed that a preamble is generally not a patentably distinct limitation in a claim. However, to the extent the preamble is a limitation of the claim, it is my opinion that Cornette discloses this limitation. I note here that “coated steel stamped products” were well known and commonly used in the field at the time of (and well before) the Priority Date. As such, without reviewing any

reference, a PHOSITA would have understood that the preamble's recitation of "a coated steel stamped product" was not novel.

67. A PHOSITA reviewing Cornette would have also understood that Cornette discloses embodiments of a coated steel stamped product. For example, 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.



Cornette, Ex. 1004, Figure 21

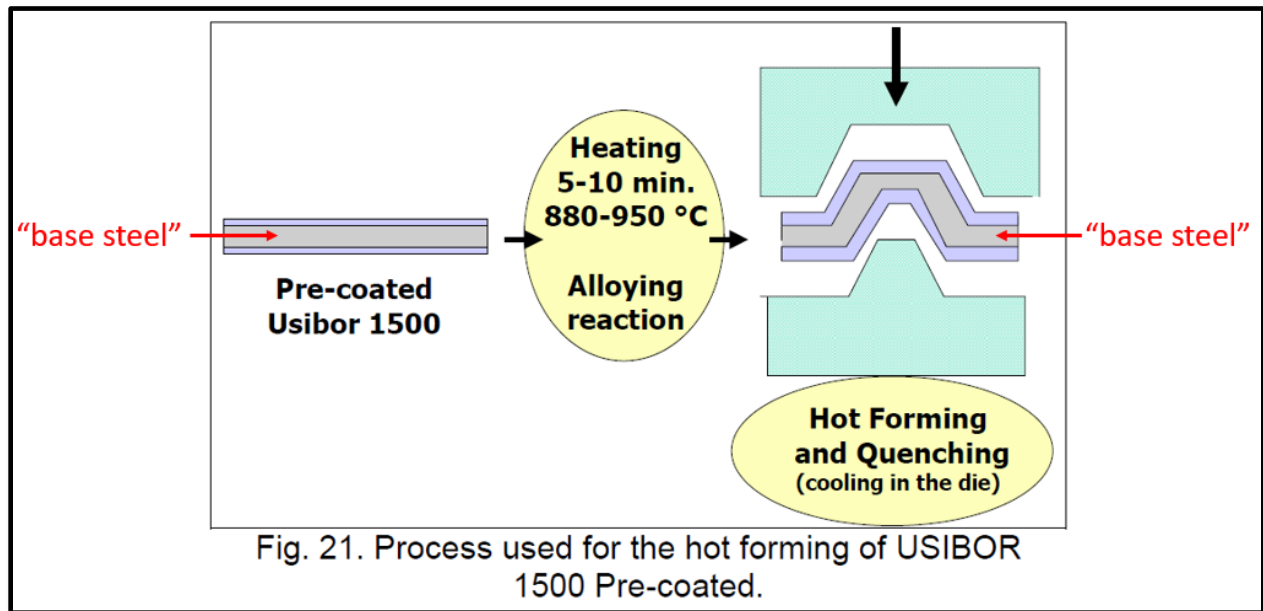
68. Cornette's Figure 21, above, shows a coated steel stamped product produced (or manufactured) through hot forming. As seen in Figure 21, the steel

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).

69. Therefore, in my opinion, Cornette discloses “a coated steel stamped product.”

a. “a strip of base steel having a first side and a second side”

70. In my opinion, upon review of at least Cornette’s Figure 21, a PHOSITA would have understood that Cornette’s coated steel stamped product includes a strip of base steel having a first side and a second side.



Cornette, Ex. 1004, Figure 21

71. As shown above, 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”).

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

72. The section in which Figure 21 appears and the surrounding text confirms my understanding that Figure 21 shows a strip of steel (*e.g.*, grey material in Figure 21) having a first side and a second side. 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).”).

73. Cornette also discloses mechanical characteristics for a coated steel stamped product obtained after hot forming using a “ISO 20x80 type” test. Ex. 1004 at 10. In my view, a PHOSITA would have understood the “ISO 20x80

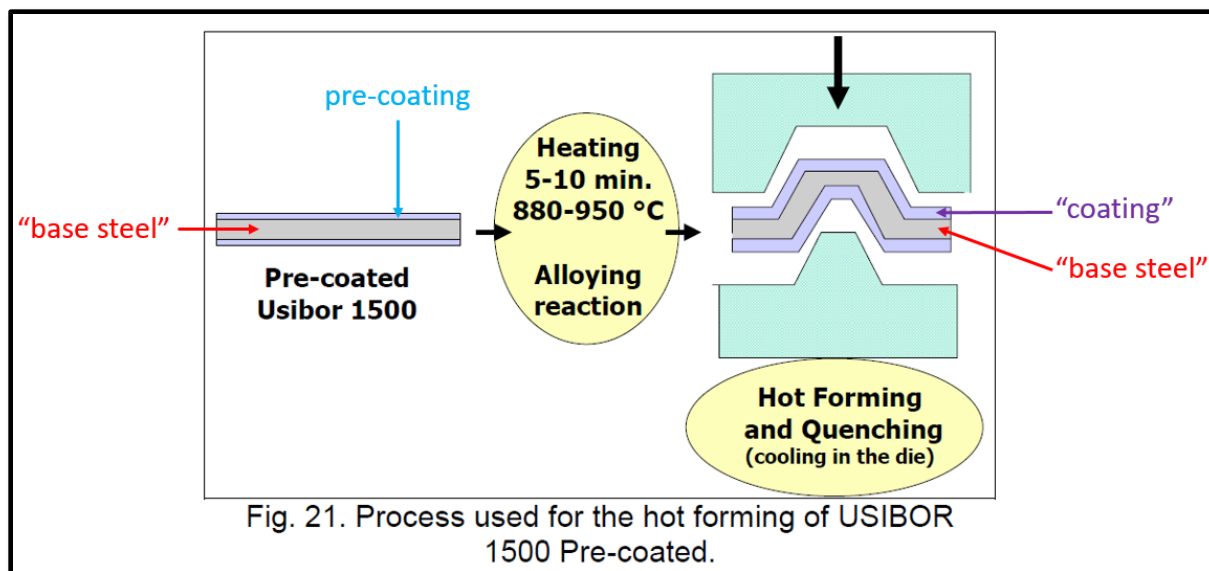
type” test to mean testing a 20x80 mm piece of steel (*i.e.*, a strip of steel). *See*, *e.g.*, Ex. 1036 at 6 (explaining that the “tests were carried out on tensile test pieces of the type ISO 20x80 mm taken from hot rolled strip” of steel)].

74. Therefore, in my opinion, Cornette discloses “a strip of base steel [*e.g.*, Usibor 1500] having a first side and a second side.”²

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”

75. In my opinion, upon review of at least Figure 21 of Cornette, a PHOSITA would have understood that Cornette’s coated steel stamped product includes a coating on both the first and second sides of the strip of base steel.

² I note that claim 1 does not impose any size limitations on the “strip of base steel.” As such, it appears to me that 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.



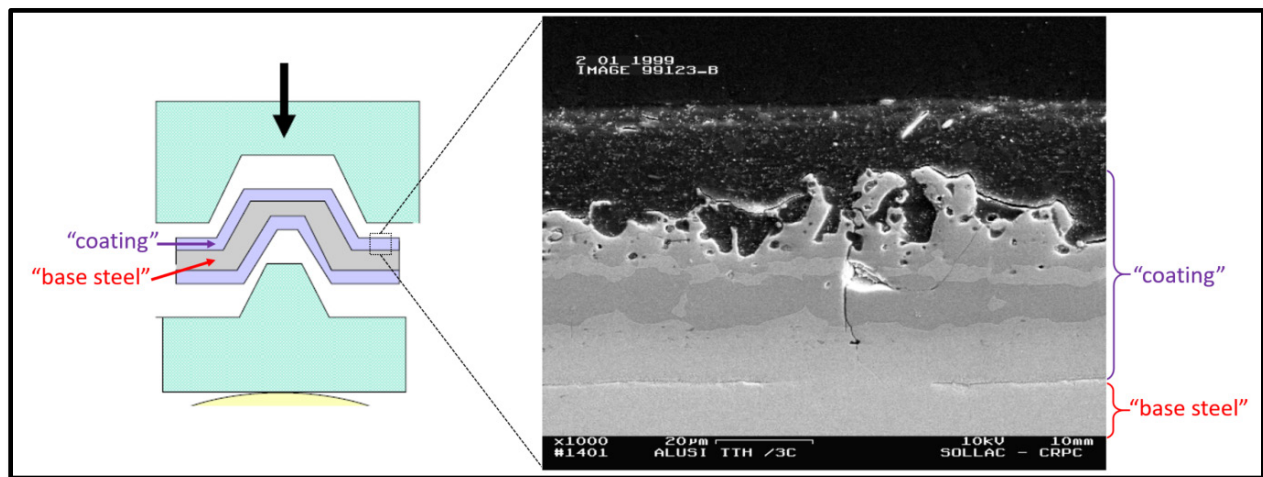
Cornette, Ex. 1004, Figure 21

76. As shown above, Cornette's Figure 21 illustrates a pre-coated boron base steel (*e.g.*, Usibor 1500) before heating (left) and after heating (right). A PHOSITA would have recognized, in my opinion, that each representation of the boron steel in Figure 21 includes a strip of base steel coated on both sides with a coating. Because of this, I believe that Cornette's Figure 21 alone establishes that Cornette discloses a coating on at least one side of a base steel. It is also my opinion that additional descriptions in the "PRE-COATED BORON STEEL" section of Cornette would have confirmed a PHOSITA's understanding that Cornette teaches this element.

77. *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”).³

78. *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”). I note here that Figure 22 is shown with Figure 21, below, to provide context to the SEM image of Figure 22.



Cornette, Ex. 1004, Figures 21 and 22

³ I note that Cornette uses the phrases “multiphase alloy layer” and “Fe-Al-Si layer” interchangeably, and these two terms correspond to the claimed “coating.”

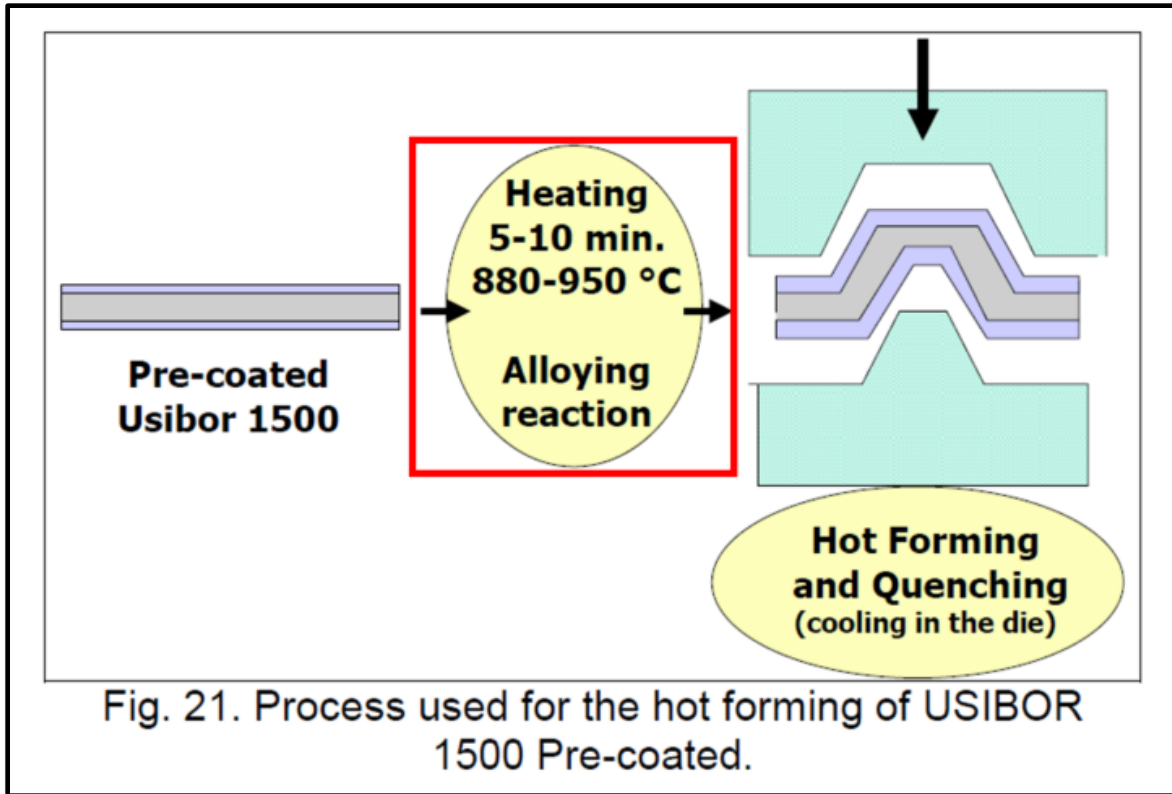
79. Thus, a PHOSITA would have appreciated, based on the text and figures following Figure 21, that Cornette's coating (*i.e.*, the multiphase alloy layer) is formed on at least one side of the strip of base steel.

80. Therefore, in my opinion, 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"

81. As discussed in the claim construction section above, it is my opinion that "interdiffusion" means "intermingling of the molecules of two or more substances."

82. It is also my opinion that, upon review of at least Figure 21 of Cornette, a PHOSITA would have understood that Cornette's coating (*i.e.*, the "multiphase alloy layer") results from the interdiffusion (or intermingling of the molecules of two or more substances) between the base steel and the aluminum or aluminum alloy pre-coating.



Cornette, Ex. 1004, Figure 21

83. For example, Cornette’s Figure 21, above, shows that Cornette’s hot forming process includes an alloying reaction (*i.e.*, an alliation reaction). This understanding would have been confirmed by related text in Cornette, stating 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”). It is also my opinion that Cornette provides additional details showing *interdiffusion* between the base steel and the pre-coating.

84. *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. From this, a PHOSITA would have recognized, in my opinion, that 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. *See* Ex. 1010 at 5 (disclosing, with regards to heat treating a pre-coated boron steel, 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”).

85. *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”). Therefore, a PHOSITA would have appreciated that heating the pre-coated boron steel causes, at a minimum, iron

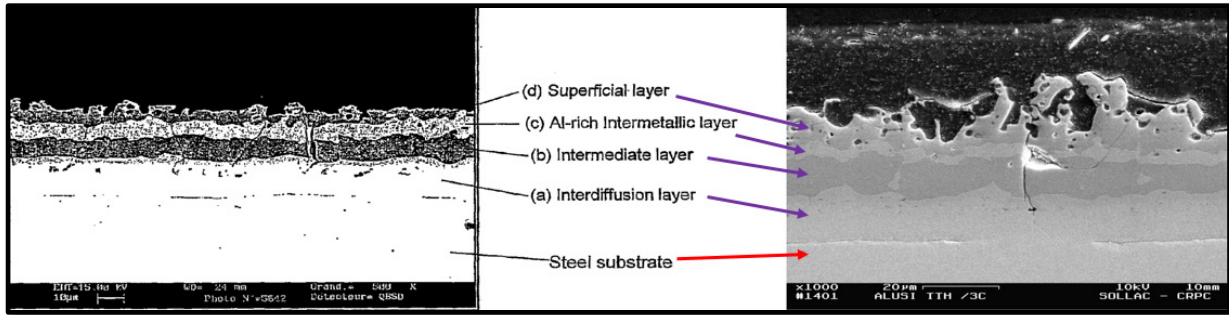
diffusion from the base steel to the coating and *vice versa* (*i.e.*, the materials mix into each other).

86. Thus, in my opinion, Cornette discloses “wherein: (i) said coating results from the interdiffusion between said base steel, and aluminum or aluminum alloy pre-coating [*e.g.*, Cornette’s 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”

87. As discussed in the claim construction section, it is my opinion that “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.”

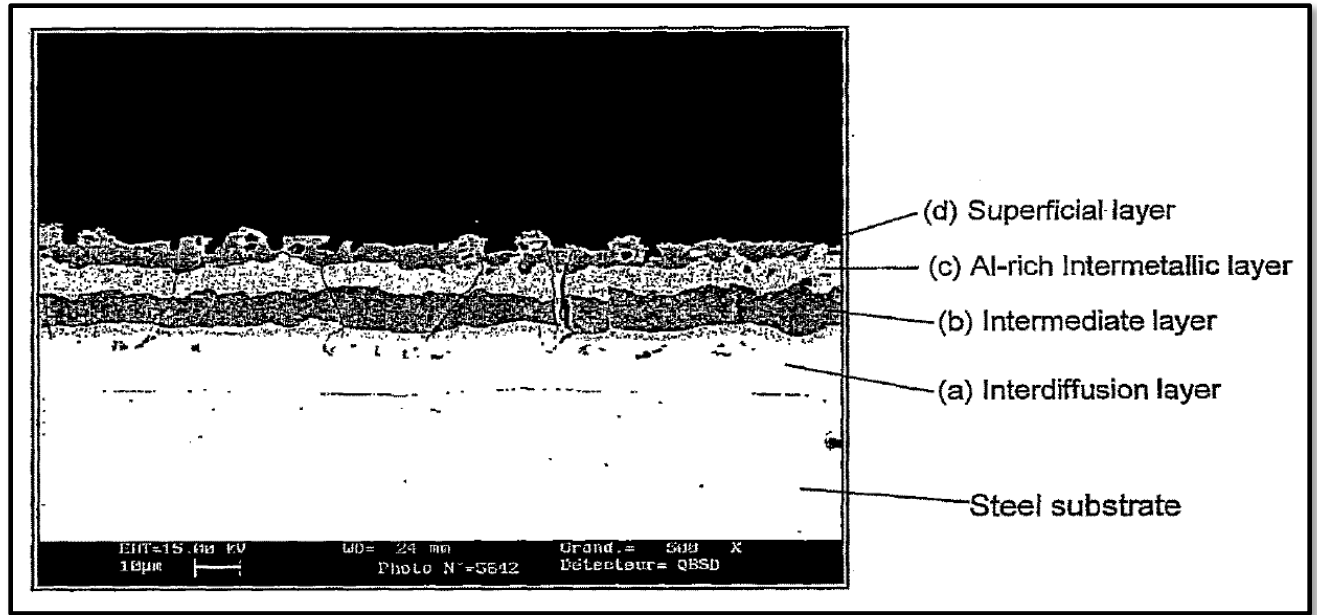
88. It is also my opinion that, upon review of at least Figure 22 of Cornette (Section view), a PHOSITA would have understood that Cornette discloses that its coating (*i.e.*, the “*multiphase* alloy layer”) comprises, proceeding from the base steel outwards: (a) an Interdiffusion layer, (b) an Intermediate layer, (c) an Intermetallic layer, and (d) a Superficial layer.

**'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. Just like Figure 1 from the '683 patent, a PHOSITA would have recognized that 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).

89. It is my belief that, while the four phases/layers are not labeled in Cornette's Figure 22, 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 patent. 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.



'683 Patent, Ex. 1001, Figure 1

90. 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.

91. 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, in my opinion, 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.

92. Furthermore, and just like the '683 patent, a PHOSITA would have appreciated that 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”**).

93. Cornette also 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. *See* Ex. 1004 at 9 (explaining that the pre-coating includes aluminum (Al) and silicon (Si), but not iron (Fe)). Therefore, in Cornette's multiphase alloy layer (*i.e.*, the Fe-Al-Si layer), it is my belief that 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).

94. As I also 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), it is my opinion that 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).

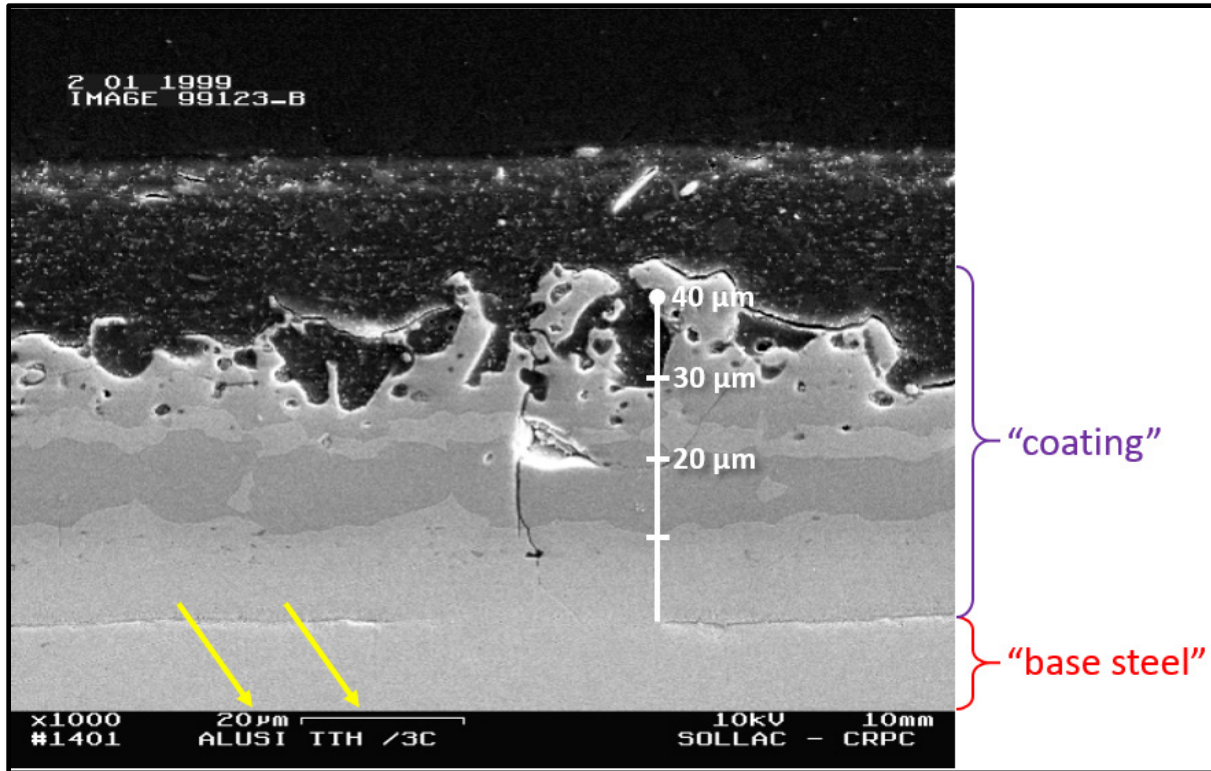
95. My opinions above that Cornette discloses the claimed four layer structure are further supported by the fact that Cornette's coating and the '683 patent's coating have similar weldability properties. For example, the '683 patent discloses that the "inventors have also discovered that particularly good weldability of aluminized and hot-stamped parts is associated with a special succession of coating layers on the parts, proceeding from steel substrate outwards." Ex. 1001 at 2:64-67; *see id.* at 3:57-62 (same). In particular, the '683 patent advances that conditions according to the invention (*i.e.*, the succession of coating layers) achieved a weldability range of 1.4 kA. Ex. 1001 at 13:42-43. Similarly, Cornette discloses that the coated steel stamped product achieved a weldability range of 2.1 kA, which is comparable with, and in fact better than, the weldability range achieved by the '683 patent. Ex. 1004 at 10. The similarity in weldability ranges between Cornette and the '683 patent thus supports my conclusion that the four phases/layers shown in Cornette's Figure 22 correspond to

the claimed interdiffusion layer, intermediate layer, intermetallic layer, and superficial layer.

96. As such, in my opinion, 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].”

e. “wherein said coating has a thickness greater than 30 micrometers”

97. In my opinion, Cornette discloses that the coating in the final coated steel stamped product has a thickness greater than 30 micrometers. For example, 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, which confirms my understanding that Cornette’s coating (*i.e.*, the multiphase alloy layer) has a thickness greater than 30 micrometers.



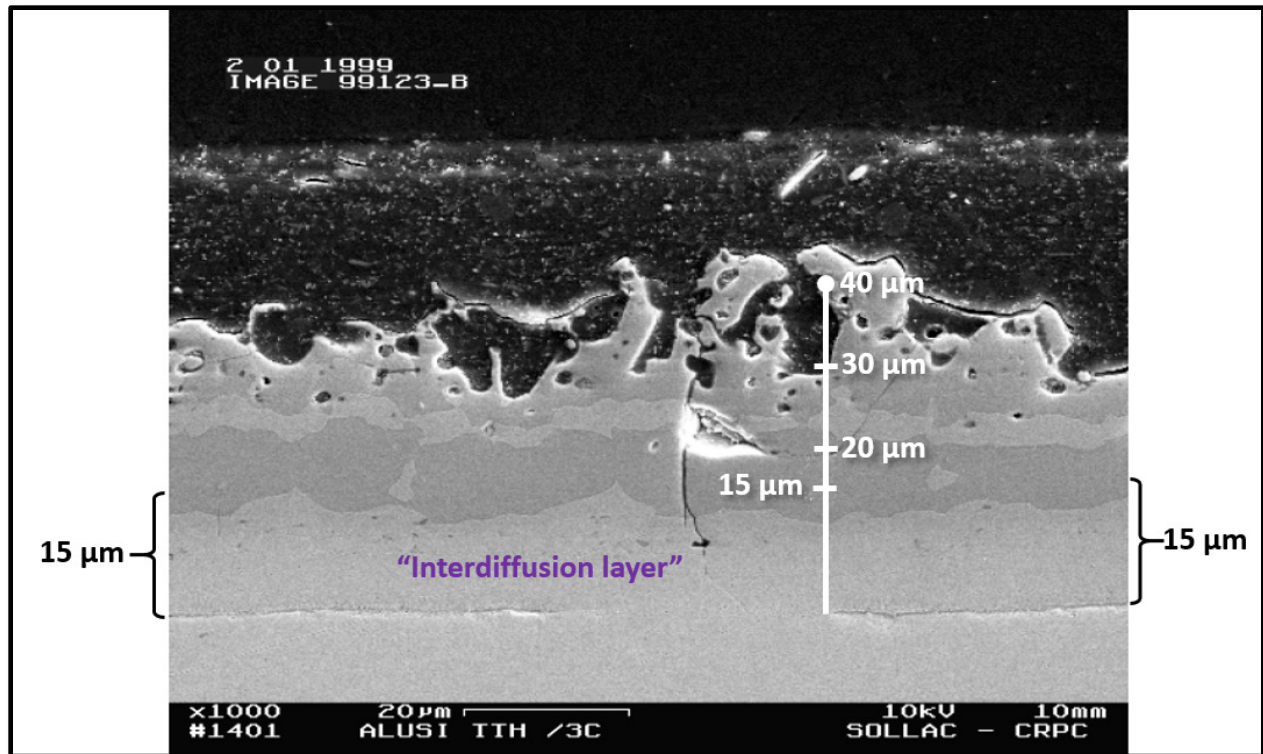
Cornette, Ex. 1004, Figure 22 (Section view)

98. In the illustrated example, Cornette’s multiphase alloy layer (which I have labeled as the “coating”) has a thickness of about 40 μm at the annotated location (and numerous other locations). I note here that I obtained the measurement annotations on Figure 22 above using the 20 μm scale provided in Cornette’s Figure 22, which is common practice for a PHOSITA. *See* 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). Because Cornette (Ex. 1004) was obtained directly from SAE’s (as is common practice), I am confident that the 20 μm scale provided in Cornette’s Figure 22 is accurate and trustworthy.

99. As such, in my opinion, Cornette discloses “wherein said coating [e.g., the multiphase alloy layer] has a thickness greater than 30 micrometers [e.g., typically about 40 micrometers].”

f. “wherein said layer (a) has a thickness less than 15 micrometers”

100. In my opinion, a PHOSITA would have understood that Cornette also discloses that the layer next to the base steel, *i.e.*, the claimed “Interdiffusion layer,” has a thickness less than 15 micrometers.



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

101. For example, as shown in Figure 22, above, Cornette’s multiphase alloy layer includes an “Interdiffusion layer” with a thickness that is less than 15 micrometers at the annotated location (same location I discussed in the preceding

section). Again, I note here that I obtained the measurement annotations on Figure 22 above using the 20 μm scale provided in Figure 22 of Cornette. I would also point out that the '683 patent does not provide any different meaning for the well-known term "thickness," and therefore, it is my opinion that a layer with any portion having a thickness value that is less than 15 micrometers satisfies this claim element. Once more, as shown above, a PHOSITA would have recognized that Cornette's interdiffusion layer has a thickness less than 15 micrometers at the annotated location (and numerous other locations in this portion shown by the SEM image).

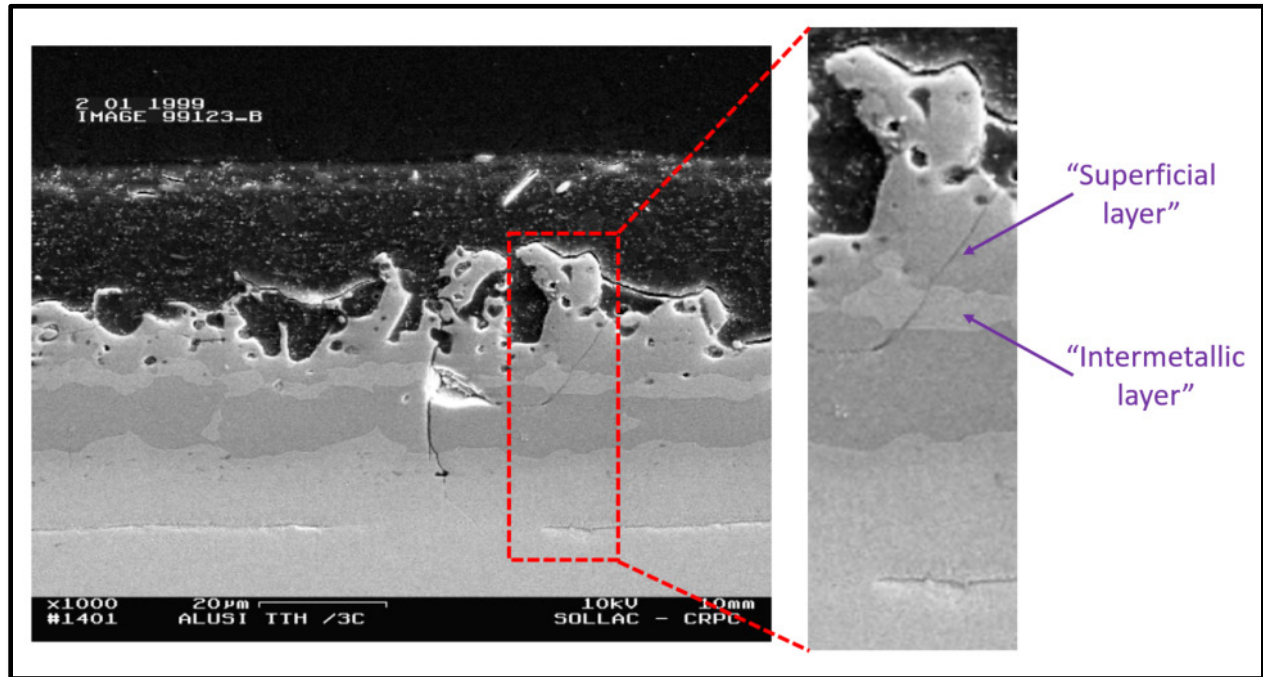
102. As such, in my opinion, Cornette discloses "wherein said layer (a) has a thickness less than 15 micrometers."

103. Thus, because Cornette discloses each and every element of claim 1, I conclude that claim 1 is anticipated by Cornette.

2. Claim 2

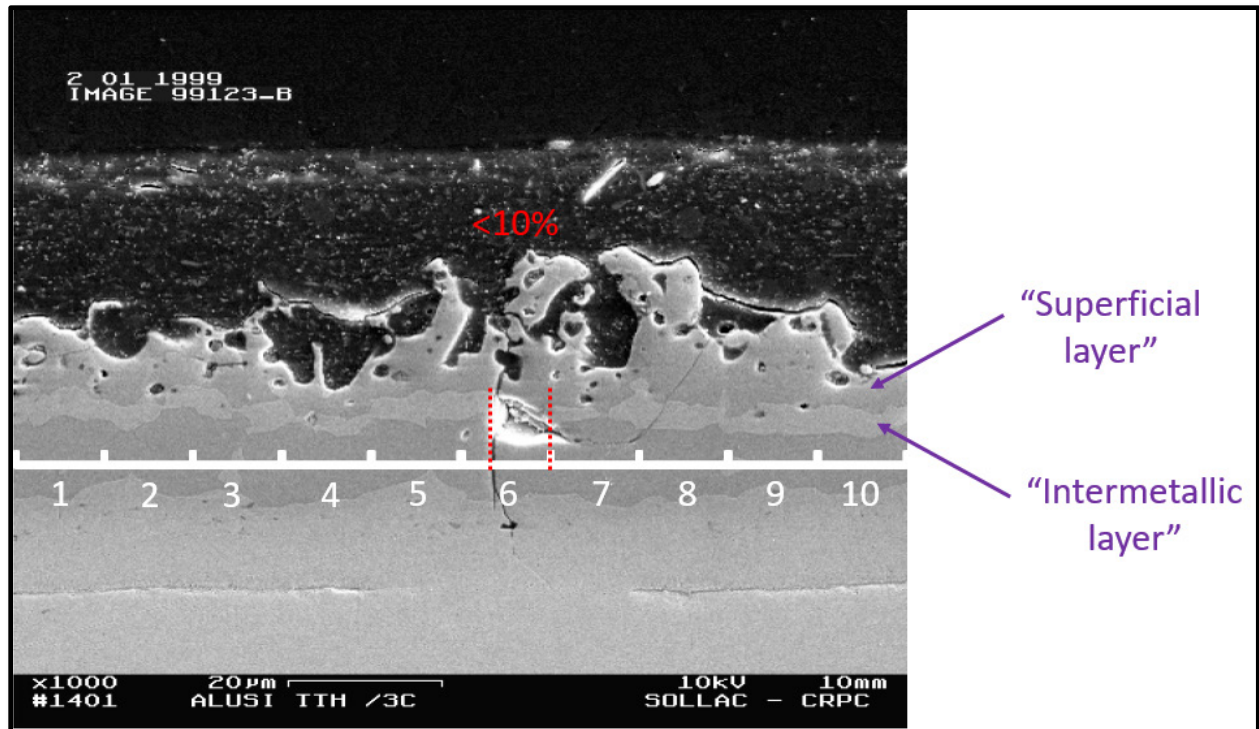
104. Claim 2 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 2 adds "[2a] wherein the said layers (c) and (d) are quasi continuous by occupying at least 90% of a level corresponding to each said layer" and "[2b] wherein less than 10% of layer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

105. In my opinion, upon review of at least Figure 22 of Cornette (Section view), a PHOSITA would have understood that Cornette discloses the elements of claim 2.



Cornette, Figure 22 (Section view)

106. For example, a PHOSITA would have appreciated, in Cornette's multiphase alloy layer (shown above), that the "Superficial layer" and "Intermetallic layer" extend continuously or essentially continuously (*e.g.*, as illustrated in the segment of Figure 22 enlarged above). Based on my reading of claim 2, it 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)

107. Even across the entire SEM image in Figure 22, above, a PHOSITA would have understood that 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.” While I cannot say for certain, it is highly likely that the annotated segment above is an artifact, made post-processing, which would mean that Cornette’s intermetallic layer *was* fully

continuous after processing. Regardless, in my opinion, Cornette discloses element [2a].

108. As to element [2b], a PHOSITA would have appreciated that Cornette's "Intermetallic layer" does not extend to the outer surface of the product in Figure 22 above (*e.g.*, the pale color of the "Intermetallic layer" does not penetrate through the darker "Superficial layer"). Therefore, in my opinion, Cornette also discloses this element of claim 2 (*i.e.*, the "Superficial layer" is continuous).

109. Therefore, I believe that Cornette anticipates claim 2.

B. Ground #2: Cornette renders dependent claims 8 and 11 obvious

1. Claim 8

110. Claim 8 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 8 adds "[a] land motor vehicle comprising the heat treated coated steel product according to claim 1."

111. 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”).

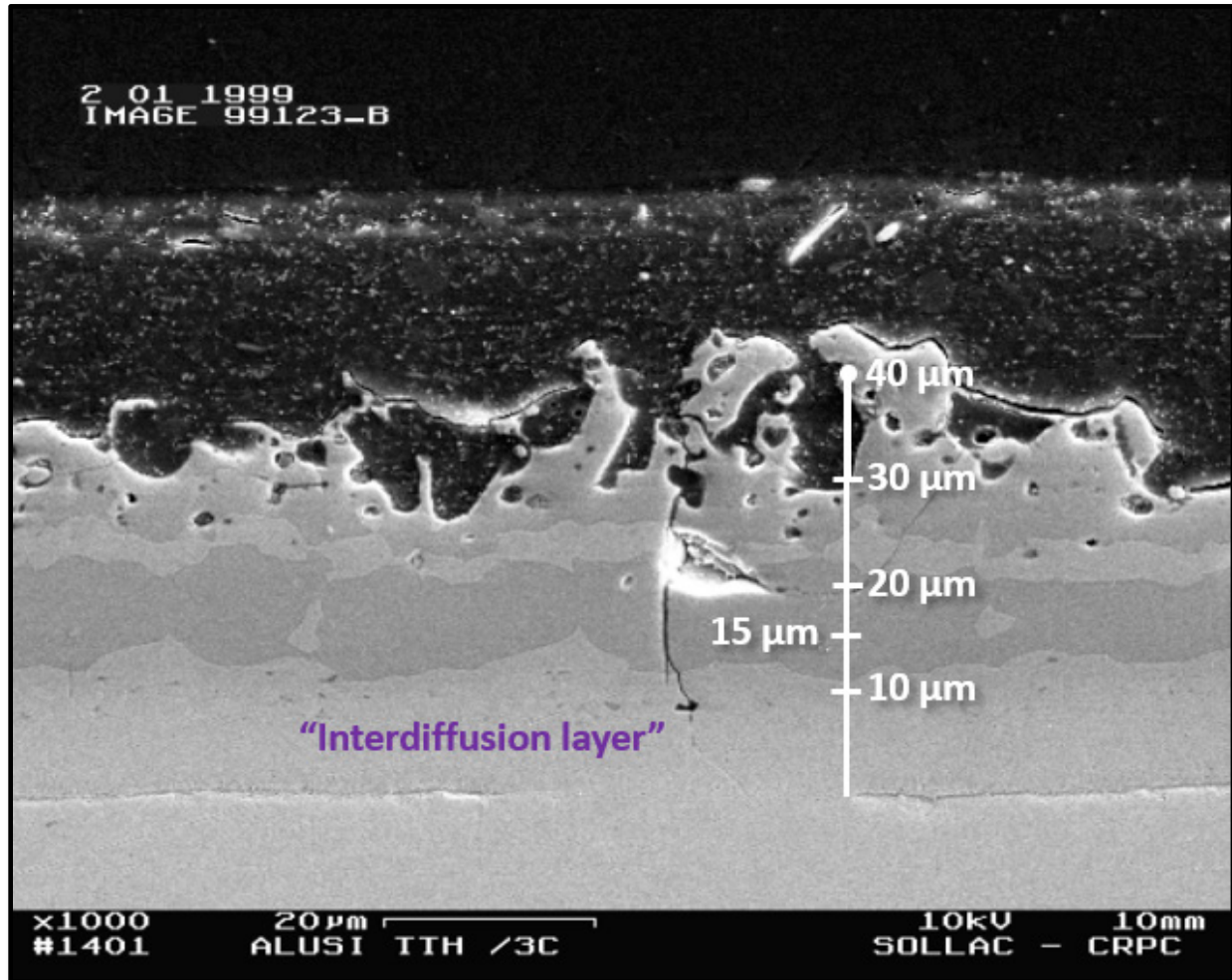
112. Accordingly, in my opinion, a PHOSITA would have understood that the components described in Cornette, including a hot-stamped component made from pre-coated boron steels (*e.g.*, Usibor 1500), are to be incorporated into an automobile/car, *i.e.*, a land motor vehicle. A PHOSITA would have been motivated to include Cornette’s heat treated steel stamped products in a land motor vehicle, in my opinion, 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 highly desirable outcomes. Ex. 1004 at 11.

113. As such, I believe that Cornette renders claim 8 obvious.

2. Claim 11

114. Claim 11 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 11 adds “wherein said layer (a) has a thickness less than 10 micrometers.” In my opinion, upon review of

at least Figure 22 of Cornette (Section view), a PHOSITA would have understood that Cornette teaches or suggests the elements of claim 11.



Cornette, Figure 22 (Section view)

115. For example, as shown in Figure 22, above, Cornette’s “interdiffusion layer” has a thickness *very close to* 10 micrometers (e.g., approximately 10.5 micrometers in at least one location). I have been informed that “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). To help me understand this concept, I have also been informed that the Federal Circuit in *Titanium Metals* 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.*

116. Likewise, here, a thickness of Cornette’s interdiffusion layer (*e.g.*, approximately 10.5 micrometers at the annotated location) is so close to the claimed thickness that, in my opinion and to use a quote from *Titanium Metals*, “one skilled in the art would have expected them to have the same properties.” My position here 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).

117. Rather, in my opinion, 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. Thus, a PHOSITA would have understood from the ’683 patent that an interdiffusion layer of precisely less than 10 μm is not critical, in my opinion.

118. In view of the above, I believe that Cornette renders claim 11 obvious.

119. In addition, it is also my opinion that a PHOSITA, through routine experimentation, would have been able to successfully reduce a thickness of a interdiffusion layer by adjusting the heat treatment applied to the pre-coating boron steel described by Cornette. Indeed, I submit that it was common knowledge during the relevant time period that a thickness of a diffusion coating (e.g., on a steel stamped product) could be reduced by lowering (i) the heating time and/or (ii) the process temperature. *See* Ex. 1043 at 53:18-21 (explaining that “quenched steel sheets having alloy layers different in thickness and alloyed up to the surface” can be “obtained by changing the deposit amounts [of the aluminum pre-coating] and **heating times**”). My opinion here is supported by the following: the interface between the Al-Si coating and the base steel provides a strong concentration gradient, while the elevated temperature (e.g., approximately 900°C) provides

energy to make atoms mobile so that they cross the interface, with Fe atoms moving into the coating while Al and Si atoms move into the steel. The distance the atoms are to travel on both sides of the interface is a function of time and temperature, which is a well-known materials science property. In light of this well-known property, in my opinion, a thickness of Cornette's multiphase alloy layer, including the interdiffusion layer, could be reduced slightly (*e.g.*, a 1-2 μm reduction) by dropping the processing temperature from 900°C to 890°C and/or the heating time from 5 minutes to 4.5 minutes, as one example.

120. To reiterate, it is my belief that adjusting the heat treatment applied to the pre-coated boron steel to reduce a thickness of the interdiffusion layer could be accomplished through routine experimentation. As one example experiment, sheet specimens of the base steel (*e.g.*, Usibor 1500) could be coated with the same thickness of pre-coating alloy, then placed in a furnace at 900°C for different periods of time (*e.g.*, 4, 4.25, 4.5, 4.75, and 5.0 minutes). After removal from the furnace, the specimens could be sectioned, mounted, and polished for examination under a microscope. The thickness of the coating, and the various sublayers (*i.e.*, phases) of the coating, including the interdiffusion layer, could then be measured (as is standard procedure). In this case, the temperature would be the same for each specimen, and as a result, I would expect the interdiffusion layer, for

example, to get progressively thicker going from a heating time of 4.0 minutes up to 5.0 minutes—the heating time used in Cornette.

121. For these additional reasons, I submit that a coated steel stamped product with a 10 μm or less interdiffusion layer is neither novel nor nonobvious.

C. Ground #3: Cornette in view of Laurent renders dependent claims 3-4, 6-7, and 10 obvious

1. Claim 3

122. Claim 3 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 3 adds “[3a] 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

“[3b] further comprises iron and impurities inherent in processing.”

123. The table below compares the claimed ranges against values disclosed by Laurent.

<u>Claimed Ranges of the Claimed Steel</u>	<u>Values of Laurent's Disclosed Steel</u>	<u>Met by Laurent?</u>
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.

124. 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 (“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).⁴

125. As to element [3b], 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.

126. Thus, I believe that Laurent teaches the elements [3a] and [3b].

2. Claim 4

127. Claim 4 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 4 adds “[4a] 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%;

⁴ I note that a chemical composition of the underlying base steel would not change as a result of the added coating, heat treatment, and stamping.

- phosphorus<0.05%;
- sulfur<0.03%;
- 0.0005%<boron<0.01%; and

“[4b] further comprises iron and impurities inherent in processing.” I note here that the ranges recited in claim 4 are narrower than the ranges recited in claim 3 (except for aluminum and chromium, which are the same in both claims).

<u>Claimed Ranges of the Claimed Steel</u>	<u>Values of Laurent's Disclosed Steel</u>	<u>Met by Laurent?</u>
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.

128. As shown above, each value disclosed by Laurent is within the corresponding claimed range and, thus, Laurent discloses element [4a].

129. As to element [4b], Laurent discloses this portion of claim 4 for the reasons I stated above in section XI.C.1 as to element [3b], incorporated here.

130. There are many reasons why a PHOSITA, in my opinion, 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.”).⁵ Moreover, as I 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.

131. *Second*, Cornette does not disclose specific *values* for each component of the pre-coated boron steel (*i.e.*, Usibor 1500). Rather, Cornette discloses an

⁵ This is not surprising as Cornette and Laurent share a common contributor: Jean-Pierre Laurent.

acceptable *range* for each component (*e.g.*, carbon, manganese, silicon, etc.) of the pre-coated boron steel. Therefore, in my opinion, 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.

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

<u>Cornette Ranges</u>	<u>Laurent Values</u>	
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%	✓

133. 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). Moreover, I also believe that 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). 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, in my opinion.

134. Thus, I believe that Cornette in view of Laurent renders claims 3 and 4 obvious.

3. Claim 6

a. Laurent Teaches This Limitation

135. Claim 6 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 6 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.

136. A PHOSITA would have recognized, however, that Laurent 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 also discloses a specific example of a base steel sheet having a titanium content of 0.032% and a nitrogen content of 0.0040%, which yields a titanium to nitrogen ratio of 8. *Id.* at 3:38-42.

137. Thus, Laurent discloses this element in my opinion.

b. Motivation to Combine Cornette with Laurent

138. A PHOSITA would have combined Cornette and Laurent for the reasons I stated in section XI.C.2, incorporated here.

139. 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). Thus, in my opinion, Cornette’s silence as to nitrogen does not mean that nitrogen is absent from Cornette’s boron steel—Usibor 1500.

140. 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 a steel’s 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. 1036 at 2 (“To prevent the combination of boron and nitrogen, the Ti/N ratio must be above 3.42 in order to obtain the effective protection of boron, this latter being added to increase the hardenability”); Ex. 1008 at 4:25-28 (explaining that the titanium to nitrogen ratio in excess of 3.42 “is introduced in order to prevent combining of the boron with the nitrogen, the nitrogen being combined with titanium”). 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.

141. Knowing the above, and in light of Cornette’s failure to discuss nitrogen, a PHOSITA wanting to make a coated stamped steel part 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), in my opinion.

142. Thus, I believe that Cornette in view of Laurent renders claim 6 obvious.

4. Claim 7

a. Laurent Teaches This Limitation

143. Claim 7 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 7 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.

144. A PHOSITA would have recognized, however, that Laurent 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, in my opinion, a PHOSITA would have recognized that Laurent’s aluminum bath would have impurities as a result of the processing. *See* Ex. 1010 at 3 (disclosing the same aluminum coating as the claimed coating, and also noting that the “remainder of the bath is composed of aluminum and impurities”). 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.

145. Thus, Laurent teaches this element in my opinion.

b. Motivation to Combine Cornette with Laurent

146. A PHOSITA would have combined Cornette and Laurent for the reasons I stated in section XI.C.2, incorporated here.

147. 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, in my opinion. 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).

148. Indeed, it is my understanding that the claimed coating is similar to the industry standard coating. *See* Ex. 1043 at 14:5-9 (disclosing that the "method most widely employed industrially at present is the hot dip plating method, and usually Al-10%Si is frequently used in a plating bath and Fe is contained therein as an unavoidable impurity"). Therefore, in my opinion, a PHOSITA would have had a reasonable expectation of success in combining Cornette with Laurent in the

proposed manner as Laurent's aluminum alloy pre-coating is similar to the industry standard coating.

149. As such, I believe that Cornette in view of Laurent renders claim 7 obvious.

5. Claim 10

a. Laurent Teaches This Limitation

150. Claim 10 depends on claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 10 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, in my opinion. Ex. 1004 at 10 (explaining that the coated stamped steel product after heat treatment has an ultimate tensile strength (UTS) of 1510 MPa). Nevertheless, Cornette lacks explicit disclosure of a full martensitic structure.

151. 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.

152. Thus, Laurent teaches this element in my opinion.

b. Motivation to Combine Cornette with Laurent

153. A PHOSITA would have combined Cornette and Laurent for the reasons I stated in section XI.C.2, incorporated here.

154. 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. *See, e.g.*, Ex. 1004 at 1 (Title: “High Strength Steels For Automotive Safety Parts”). A PHOSITA would have also appreciated that Laurent 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 an ultimate tensile strength of 1500 MPa was achieved “after austenitization at 900°C [for] 5 minutes”). Therefore, in my opinion, 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.

155. I note 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, which is 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.

156. As such, I believe that Cornette in view of Laurent renders claim 10 obvious.

D. Ground #4: Cornette in view of Laurent, EP Laurent, and FR Laurent renders dependent claim 11 obvious

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

157. Claim 11 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 11 adds "wherein said layer (a) has a thickness less than 10 micrometers." Per my explanation above, Cornette renders claim 11 obvious. If the Board finds claim 11 to be nonobvious over Cornette, claim 11 is rendered obvious by Cornette in view of Laurent, EP Laurent, and FR Laurent, in my opinion.

158. As I discussed earlier, 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.

159. Accordingly, in my opinion, 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.” *See* Ex. 1043 at 53:18-21, 53:1-2 (explaining that “quenched steel sheets having alloy layers different in thickness and alloyed up to the surface were obtained by changing the deposit amounts...” of the pre-coating, whereby the deposit amounts were adjusted between 30 to 80 g/m^2). In other words, a PHOSITA would have appreciated that 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.

160. Additionally, as I explained above, 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, a PHOSITA would have recognized that 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, in my opinion, 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.

161. In sum, it is my belief that 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: (i) having thinner phases/layers, including a thinner

“Interdiffusion layer” (*e.g.*, less than 10 μm thick), and (ii) having 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).

2. Motivation to Combine Cornette with Laurent, EP Laurent, and FR Laurent

162. In my opinion, a PHOSITA would have combined Cornette, Laurent, EP Laurent, and FR Laurent for reasons analogous to those I stated in section XI.C.2, incorporated here, as to Laurent.⁶ 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.

163. Also, and in addition to these references each being directed to the same field of endeavor (*i.e.*, coated steel stamped products), it is also my understanding that 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

⁶ I used FR Laurent in this section to show that a 50% increase in coating thickness can be expected with certain heat treatments.

reasons I stated in section XI.C.2, as to Laurent, apply equally to EP Laurent and FR Laurent.

164. For claim 11 in particular, it is my opinion that 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). Further, I also believe that 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). Because of this, a PHOSITA would have been motivated to reduce the pre-coating thickness in order to save costs. 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, in my opinion.

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

166. As such, I believe that Cornette in view of Laurent, EP Laurent, and FR Laurent renders claim 11 obvious.

167. I also note that the obvious changes to the heat treatment explained in section XI.B.2 could be made in tandem with the proposed combination of Cornette in view of Laurent, EP Laurent, and FR Laurent. If so, in my opinion, a PHOSITA would have had more than a reasonable expectation of success in making a coating steel stamped product having an interdiffusion layer that is less than 10 μm (while also meeting the limitations set forth in claim 1).

E. Ground #5: Cornette in view of Nishibata renders dependent claim 5 obvious

1. Nishibata Teaches This Limitation

168. Claim 5 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 5 adds “wherein the base steel comprises 20 ppm or less of sulfur.” As shown in Cornette’s Table III, below, Usibor 1500 has a sulfur content up to 0.008%, which converts to 80 ppm (*i.e.*, ≤ 80 ppm).⁷ Ex. 1004 at 9.

⁷ To convert a percentage to parts per million (ppm), the percentage is multiplied by 10,000 (*i.e.*, 0.008% converts to 80 ppm).

CHEMICAL COMPOSITION OF THE BASE MATERIAL

USIBOR 1500 is a carbon-manganese steel microalloyed with boron.

Table III. Chemical composition of pre-coated boron steel in thousandths of percent

	C	Mn	Si	S	Cr	Al	B	Ti
Min.	200	1100	150		150	20	2	20
Max.	250	1350	350	8	300	60	4	50

Ex. 1004 at 9.

169. Cornette does not provide explicit disclosure of “20 ppm or less.”

170. Nishibata, however, describes several working examples of 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.

171. As shown above in Table 1, Steel No. 2 has a sulfur content of 20 ppm.⁸

172. Thus, Nishibata discloses claim 5 in my opinion.

2. Motivation to Combine Cornette with Nishibata

173. There are many reasons why a PHOSITA, in my opinion, would have looked to other 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.”).

174. *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

⁸ I note here that Steel No. 2 also satisfies the elements for claims 3, 4, and 6. I include this note here to further demonstrate that the claimed steel was well-known before the Priority date.

formability” of the steel); Ex. 1043 at 18:15-17 (explaining “[sulfur] is an element which is included unavoidably and causes the deterioration of *workability*” of a boron steel and “it is necessary to decrease the amount as much as possible”). 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). Knowing this, in my opinion, 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).

175. *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). As I discussed above, 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).

176. 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. Either way, in my opinion, a PHOSITA would have reduced his/her time experimenting with the ranges disclosed by Cornette. Additionally, because the combination here is straightforward (*i.e.*, maintaining the sulfur content in steel below 20 ppm), a PHOSITA would have had a reasonable expectation of success in making the proposed modification. Indeed, even back in 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 Priority date. Ex. 1035 at 4.

177. Thus, I believe that Cornette in view of Nishibata renders claim 5 obvious.

F. Ground #6: Cornette in view of Somani renders dependent claim 9 obvious

1. Somani Teaches This Limitation

178. Claim 9 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 9 adds "wherein the product is hot formed with a strain higher than 10% and cooled with a cooling rate higher than 50° C./s."

179. I have been informed by Petitioner that claim 9 is a "product-by-process" claim where the product is defined at least in part in terms of the method or process by which it is made. Petitioner has also informed me that if 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.

180. 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, in my opinion, does not add any structure to the claimed coated steel stamped product of claim 1. To the extent that Patent Owner argues or the Boards finds that claim 9 is entitled to patent weight, claim 9 is nonetheless rendered obvious by Cornette in view of Somani, as I explain below.

181. 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.

182. A PHOSITA would have also understood that cooling rates greater than 50° C./s are not novel. Such an understanding is confirmed by Somani, which

notes that in hot-stamping processes, “[t]ypical cooling rates of the order of 100°C/s have been estimated.” *Id.* at 366. I would also like to note that a strain of 10% is a low amount of strain (*i.e.*, in my experience, most stamped parts undergo strains much higher than 10% during a stamping process). In light of this, a PHOSITA would have also understood that strains greater than 10% are common and thus not novel, in my opinion. *See id.* at 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”).

183. In any event, I believe that Somani teaches “a strain higher than 10%” (*e.g.*, 24%) and “a cooling rate higher than 50° C./s” (*e.g.*, 280° C/s).

2. Motivation to Combine Cornette with Somani

184. There are many reasons why a PHOSITA, in my opinion, 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”).

185. *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, in my opinion, 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.

186. 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). Because of this, I believe that 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). 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, in my opinion.

187. I also note that Cornette discusses strain values and cooling rate for TRIP steels. *See, e.g.*, Ex. 1004 at Figure 2 (showing a strain % greater than 10%); Figure 5 (showing cooling rates greater than 50 °C/sec and demonstrating that high cooling rates lead to steels with high tensile strengths). In my view, a PHOSITA reviewing Cornette's discussion about TRIP steels would have thus understood that strain values or cooling rates are important factors when processing steels, which is yet another reason a PHOSITA would have been motivated to look to another reference, such as Somani, disclosing strain values and cooling rates for boron steels.

188. *Third*, I also believe that a PHOSITA would have 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). 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. 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 stamped steel product achieves its full potential—1500 MPa.

189. *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 and in my opinion, 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). *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, I also believe that a PHOSITA would have had a reasonable expectation of success in making the proposed modification.

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

G. Ground #7: Cornette in view of Engels renders dependent claim 11 obvious

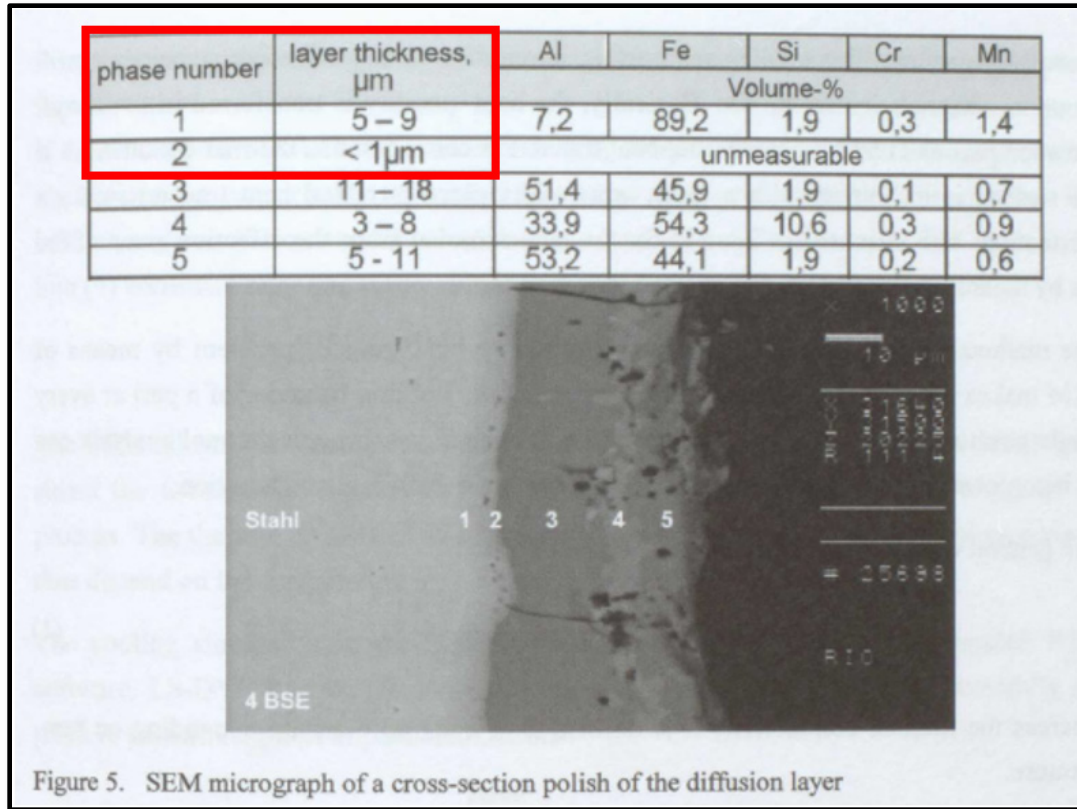
1. Engels Teaches This Limitation

191. Claim 11 depends from claim 1. As I discussed above, all the limitations of claim 1 are disclosed by Cornette. Claim 11 “wherein said layer (a) has a thickness less than 10 micrometers.” While I addressed claim 11 twice

above, in the interest of being thorough, I also believe that claim 11 is rendered obvious by Cornette in view of Engels.

192. A PHOSITA would have appreciated that 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).⁹

⁹ Engels' Figure 5 includes a 10 μm scale bar in the upper right corner, which can be used to measure the diffusion layer's thickness, as is common practice.



Engels, Ex. 1041, Figure 5

193. 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. A PHOSITA would have also noticed that Engels’ Figure 5 includes a corresponding thickness for each phase/layer of the diffusion layer. Notably (as I 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), which demonstrates, in my opinion, that “intermingling of the molecules

of two or more substances” occurred in phase 1. *See supra* § X.B.1, incorporated construing, “Interdiffusion layer”).

194. As such, Engels discloses this limitation in my opinion.

2. Motivation to Combine Cornette with Engels

195. 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).

196. *Second*, in my opinion, 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. *See, e.g.*, Ex. 1043 at 53:18-21 (explaining that “quenched steel sheets having alloy layers different in thickness and alloyed up to the surface” can be “obtained by changing the deposit amounts [of the aluminum pre-coating] and **heating times**”). 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.

197. Moreover, a PHOSITA would have recognized that 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). Because of this, a PHOSITA would have had a reasonable expectation of success in making the proposed modification.

198. *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 I demonstrated earlier, can be used to accurately measure phase thicknesses. Nevertheless, a PHOSITA interested in phase thicknesses in a coated steel stamped product would have been 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.

199. *Fourth*, and consistent with my understanding of diffusion layers, 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, in my opinion, 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 products with Engels’ “diffusion layer,” as compared to the corrosion and welding properties of Cornette’s hot-stamped product. *See* Ex. 1004 at 10 (disclosing corrosion and welding properties of Cornette’s hot-stamped products).

200. Thus, I believe that Cornette in view of Engels renders claim 11 obvious.

XII. CONCLUSION

201. For the reasons set forth above, in my opinion, claims 1-11 of the ’683 patent are anticipated or rendered obvious.

202. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine

Declaration of Dr. Michael Miles

or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the results of these proceedings.

Executed on June 28, 2019 in Springville, Utah.

A handwritten signature in blue ink, appearing to read "Mr. Miles", is written above a horizontal line.

Michael Miles

APPENDIX A: Dr. Michael Miles CV

Experience

9/09 – 12/16	Brigham Young University - Provo, UT Program Chair/Coordinator, Manufacturing Engineering Technology
9/13	Brigham Young University - Provo, UT Professor, Manufacturing Engineering Technology
9/07 – 8/13	Brigham Young University - Provo, UT Associate Professor, Manufacturing Engineering Technology
7/01 – 8/07	Brigham Young University - Provo, UT Assistant Professor, Manufacturing Engineering Technology
1/00 – 7/01	Assistant Plant Manager, Rexam, PLC - Whitehouse, OH
12/98 – 12/99	Engineering Manager, American National Can - Whitehouse, OH
5/98 – 12/98	Senior Project Engineer, American National Can – Elk Grove Village, IL
1/96 – 4/98	Tooling/Project Engineer, American National Can – Elk Grove Village, IL
2/95 – 1/96	Project Engineer, Pechiney Research Center - Voreppe, France

Education

1995, Ph.D. Materials Science and Engineering, Ecole des Mines de Paris
1991, M.S. Metallurgical Engineering, Ohio State University
1989, B.S. Metallurgical Engineering (French minor), University of Idaho

Professional Activities and Awards

2011-2013	Nominating committee, The Minerals, Metals, and Materials Society (TMS) Shaping and Forming Committee
2010	Outstanding Faculty Award, BYU School of Technology
2007- 2010	Chair, The Minerals, Metals, and Materials Society (TMS) Shaping and Forming Committee
2009 – 2011	Faculty advisor, Society of Manufacturing Engineers (SME)
2006	First place award in Society of Manufacturing Engineers (SME) manufacturing challenge competition (faculty team advisor)
2004- 2014	Treasurer and Board Member, Society for the Advancement of Materials and Process Engineering (SAMPE) - Utah Chapter
2003-2007	Faculty advisor for BYU chapter of the Society for Advancement of Materials and Process Engineering (SAMPE)
2003	First place award in Society of Manufacturing Engineers (SME) manufacturing challenge competition (faculty team advisor)
1997	Young Leader Intern for The Minerals, Metals, and Materials Society (TMS)
1990-91	Forming Limit Diagram User's Group, North American Deep Drawing Research Group (NADDRG)
1989-91	Parson's Foundation Fellow, National Science Foundation (NSF) Engineering Research Center for Net Shape Manufacturing, Ohio State University
1988	Member of Tau Beta Pi

Program Director - Asia Manufacturing Engineering Study Abroad Program

Began mentored internship study abroad in 2006 with one company in Shanghai, China. By summer of 2017, 72 students had participated in this program at 13 different companies and three countries (China, Taiwan, Vietnam). Manufacturing engineering technology students were the primary participants, but students from mechanical engineering, chemical engineering, construction management, and nursing were also involved in this 6 week program.

Declaration of Dr. Michael Miles

Graduate Student Advisement

Advisor of 29 graduated M.S. students since 2001.

Patents

T. Turner, R. Forrest, M. Miles: End Closure with Improved Openability, 2/15/2000, number 6,024,239.

S. Packer, R. Steel, J. Babb, M. Miles, K. Kohkonen: Three-body joining using friction stir processing techniques, 12/7/2010, number 7,845,545.

M. Miles, R. Fleck, R. Steel: Friction bit joining using a friction rivet, 9/19/2017, number 9,764,375.

M.P. Miles and T.W. Nelson: Friction stir additive processing, BYU disclosure 2016-017, 3/28/2016.

Expert Witness

Expert for Freshfields, Bruckhaus, Deringer in patent infringement lawsuit, London, England, September 2008 – January 2009.

Expert for Foley & Lardner LLP in patent infringement lawsuit, Washington, DC, July 2008 – October 2009.

Expert for Reed Smith LLP in personal injury lawsuit, Los Angeles, CA, January 2010 – March 2010.

Expert for Lewis and Rocca LLP in breach of contract lawsuit, Albuquerque, NM, January 2011 – July 2011.

Expert for Burr & Forman LLP in petition to the patent trial and appeal board, March 2015 – May 2015.

Expert for Covington & Burling LLP in trade secret lawsuit, Washington, D.C., December 2016.

External Funding

PI: “Development of a finite element model to predict bending limits of thick plate AA 2519”, Rockwell Scientific (DARPA subcontract), February 2003 (\$15K).

PI: “Formability of Friction Stir Welded High Strength Steel Sheet”, Society of Manufacturing Engineers Education Foundation, May 2005 (\$15K).

PI (with Co-PI Kent Kohkonen): “SGER: Friction Bit Joining - A New Solid State Spot Joining Process”, National Science Foundation, July 2008 (\$99,435)

Co-PI (with PI David Fullwood and Co-PI Brent Adams): “GOALI: Defect Detection Microscopy: Microstructure Design for Formability of Wrought Magnesium Alloys”, National Science Foundation, August 2009 (\$319,937)

PI: “Impact of PCBN tool design performance and tool life for DP 980 steel”, DOE PNNL subcontract, March 2010 (\$36,864)

PI: “Tool life and joint performance for friction stir spot welding of ultra high strength steel using reduced vertical welding loads”, DOE PNNL subcontract, July 2011 (\$37,616)

PI: “Solid state spot joining of cast iron and aluminum”, RE-EV Program, subcontract through Ulsan University, South Korea, August 2011 (\$20K)

PI: “High speed friction stir spot welding: A new method for spot joining of ultra high strength steel”, National Science Foundation, August 2011 (\$260,000)

PI (with Co-PI Paul Higgins): “Friction Bit Joining: A Novel Solution to Dissimilar Metals Joining”, TCIP State of Utah, with Megastir Technologies, January 2012 (\$40,000)

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Co-PI (with PI Zhili Feng): “Body-in-White Joining of Aluminum to Advanced High Strength Steel at Prototype Scale”, DOE, with Oak Ridge National Lab and Honda, September 2013 (\$240,000)

PI (with Co-PI David Fullwood): “Microscopic Fracture Mechanisms Evaluation for Advanced High Strength Steel”, Auto/Steel Partnership, October 2013 (\$35,000)

PI (with Co-PI Tracy Nelson): “GOALI: Crack Repair of Irradiated Stainless Steel by Friction Stir Processing”, National Science Foundation, March 2014 (\$304,999)

Co-PI (with PI David Fullwood): “Microstructural Foundations of Magnesium Performance: A Data Mining Approach to High-Throughput HREBSD”, National Science Foundation, September 2014 (\$346,362)

PI (with Co-PI David Fullwood): “Microscopic Fracture Mechanisms Evaluation for AHSS”, Auto/Steel Partnership, October 2014 (\$30,000)

Co-PI (with PI David Fullwood and Co-PI Eric Homer): “GOALI: Deformation Microscopy of Retained Austenite Transformation in TRIP Steels”, National Science Foundation, July 2015 (\$455,515)

PI (with Co-PIs Tracy Nelson and Carl Sorensen): “Development of a methodology for characterizing the tool/part interface in friction stir welding for improvement of predictive modeling in aluminum alloys” NASA, December 2018 (\$500,000)

Peer-reviewed journal papers (2013-2018): BYU student co-authors underlined

M.P. Miles, T.W. Nelson, C. Gunter, F.C. Liu, L. Fourment, T. Mathis (2019). Predicting recrystallized grain size in friction stir processed 304L stainless steel, *Journal of Materials Science & Technology*, 35(4), pp. 491-498.

T.M. Rampton, S.I. Wright, M.P. Miles, E.R. Homer, R.H. Wagoner, D.T. Fullwood (2018). Improved twin detection via tracking of individual Kikuchi band intensity of EBSD patterns, *Ultramicroscopy*, 185, 5-14.

J.M. Weaver, T. Barton, D. Jenkins, J. Linn, M.P. Miles, R. Smith (2019). Quantifying Accuracy of a Concept Laser Metal Additive Machine through the NIST Test Artifact. *Rapid Prototyping Journal*, 25(2), pp. 221-231.

J. Cramer, D. Adams, M.P. Miles, D.T. Fullwood, E.R. Homer, T. Brown, R.K. Mishra, A. Sachdev (2018). Effect of strain path on forming limits and retained austenite transformation in Q&P 1180 steel. *Materials Science And Engineering A*, 734.

A. Orme, D.T. Fullwood, M.P. Miles (2018). Evolution of Mg AZ31 twin activation with strain: a machine learning study. *Materials Discovery*, 12, 20-29.

R. Sharma, I. Chelladurai, A.D. Orme, M.P. Miles, C.G. Giraud-Carrier, D.T. Fullwood (2018). A Step Towards Intelligent EBSD Microscopy: Machine Learning Prediction of Twin Activity in MgAZ31. *Journal of Microscopy*, 272(1), 67-78.

C. Gunter, M.P. Miles, F.C. Liu, T.W. Nelson (2018). Solid state crack repair by friction stir processing in 304L stainless steel, *Journal of Materials Science & Technology*, 34(1) 140-147.

F.C. Liu, Y. Hovanski, M.P. Miles, C.D. Sorensen, T.W. Nelson (2018). A review of friction stir welding of steels: Tool, material flow, microstructure, and properties. *Journal of Materials Science & Technology*, 34(1), 39-57.

Eun-Yeong Ahn, Hrishikesh Das, Sung-Tae Hong, Kyung-Sik Han, Michael Miles, Kwang-Jin Lee, Ju-Won Park, Heung Nam Ha (2017). Process responses and resultant joint properties of friction stir welding of dissimilar 5083 and 6061 aluminum alloys, *Journal of Mechanical Science and Technology*, 31(8), 3955-3960.

Declaration of Dr. Michael Miles

I. Chelladuari, M.P. Miles, D.T. Fullwood, J.E. Carsley, R.K. Mishra, I.J. Beyerlein, and M. Knezevic (2017). Microstructure Correlation with Formability for Biaxial Stretching of Magnesium Alloy AZ31B at Mildly Elevated Temperatures. JOM, 69(5), 907-914.

J-R. Kim, E-Y. Ahn, H. Das, Y-H. Jeong, S-T. Hong, M.P. Miles, and K-J. Lee (2017). Effect of tool geometry and process parameters on mechanical properties of friction stir spot welded dissimilar aluminum alloys, International Journal of Precision Engineering and Manufacturing 18, 445-452.

Y. C. Lim, L. Squires, T.-Y. Pan, M. P. Miles, J. K. Keum, G.-L. Song, Y. Wang, Z. Feng (2017). Corrosion behaviour of friction-bit-joined and weld-bonded AA7075-T6/galvannealed DP980. Science and Technology of Welding and Joining, 22(6), 455-464.

A. D. Orme, I. Chelladurai, T. M. Rampton, D. T. Fullwood, A. Khosravani, M. P. Miles, R. K. Mishra (2016). Insights into twinning in Mg AZ31: A combined EBSD and machine learning study. Computational Materials Science, 124, 353-363.

T. Ruggles, S. Cluff, M.P. Miles, D.T. Fullwood, C. Daniels, A. Avila, M. Chen (2016). Ductility of Advanced High-Strength Steel in the Presence of a Sheared Edge. JOM, 68(7), 1839-1849.

L. Squires, Y.C. Lim, M.P. Miles, Z. Feng (2015). Mechanical properties of dissimilar metal joints composed of DP 980 steel and AA 7075-T6. Science and Technology of Welding and Joining, 20(3), pp. 242-248.

Y.C. Lim, L. Squires, T.-Y. Pan, M.P. Miles, G.-L. Song, Y. Wang, Z. Feng (2015). Study of mechanical joint strength of aluminum alloy 7075-T6 and dual phase steel 980 welded by friction bit joining and weld-bonding under corrosion medium. Materials & Design, 69(15), pp. 37-43.

T. Hartman, M.P. Miles, S.-T. Hong, R. Steel, S. Kelly (2015). Effect of PCBN tool grade on joint strength and tool life in friction stir spot welded DP 980 steel. Wear, 328-329, pp. 531-536.

D.T. Fullwood, A. Khosravani, J. Scott, M.P. Miles, R. Mishra (2015). Nucleation and propagation of twins in AZ31 magnesium alloy. Acta Materialia, 100, pp. 202-214.

M.P. Miles, U. Karki, and Y. Hovanski (2014). Temperature and Material Flow Prediction in Friction Stir Spot Welding of Advanced High Strength Steel. JOM, 66 (10), pp. 2130-2136.

N. Saunders, M. Miles, T. Hartman, Y. Hovanski, S.T. Hong, R. Steel (2014). Joint Strength in High Speed Friction Stir Spot Welded DP 980 Steel. International Journal of Precision Engineering and Manufacturing, 15(5), pp. 841-848.

Md. Abu Mowazzem Hossain, Md. Tariqul Hasan, Sung-Tae Hong, Michael Miles, Hoon-Hwe Cho, Heung Name Han (2014). Mechanical Behaviors of Friction Stir Spot Welded Joints of Dissimilar Ferrous Alloys under Opening-Dominant Combined Loads. Advances in Materials Science and Engineering, pp. 179-193.

Md. Abu Mowazzem Hossain, Md. Tariqul Hasan, Sung-Tae Hong, Michael Miles, Hoon-Hwe Cho, Heung Name Han (2014). Failure Behaviors of Friction Stir Spot Welded Joints of Dissimilar Ferrous Alloys under Quasi-Static Shear Loads. International Journal of Materials and Product Technology, 48 (1-4), pp. 179-193.

Md. Abu Mowazzem Hossain, Md. Tariqul Hasan, Sung-Tae Hong, Michael Miles, Hoon-Hwe Cho, Heung Nam Han (2013). Friction stir spot welded joints of 409L stainless steels fabricated by a convex shoulder tool. Metals and Materials International, 19 (6), pp. 1243 – 1250.

Michael Miles, Sung-Tae Hong, Coulter Woodward, Yong-Ha Jeong (2013). Spot Welding of Aluminum and Cast Iron by Friction Bit Joining. International Journal of Precision Engineering and Manufacturing, 14 (6), pp. 1003 – 1006.

Declaration of Dr. Michael Miles

A. Khosravani, J. Scott, M.P. Miles, D. Fullwood, R.K. Mishra (2013). Microstructure evolution of AZ31 magnesium alloy under different strain paths. International Journal of Plasticity, 45, 2013, pp. 160-173.

Scott D. Grimshaw, Natalie J. Blades, Michael P. Miles (2013). Spatial Control Charts for the Mean. Journal of Quality Technology, 45 (2), pp. 130-148.

Jon Scott, Michael Miles, David Fullwood, Brent Adams, Ali Khosravani, and Raja.K. Mishra (2013). Room Temperature Shear Band Development in Highly Twinned Wrought Magnesium AZ31B Sheet. Metallurgical and Materials Transactions A, 44 (1), pp. 512-516.

Peer-reviewed conference papers (2013-2018): BYU student co-authors underlined

J.M. Weaver, J. Linn, M.P. Miles, Y. Hovanski, R. Smith (2018). Characterizing Interfacial Bonds in Hybrid Metal AM Structures. Proceedings of the 29th Annual International Solid Freeform Fabrication Symposium - An Additive Manufacturing Conference. Austin, TX: Solid Freeform Fabrication.

M.P. Miles, C. Gunter, F.C. Liu, and T.W. Nelson (2017). "Friction Stir Processing of 304L Stainless Steel for Crack Repair" In Friction Stir Welding and Processing IX. (Pittsburgh, PA: MMMS, 2017), 13-22.

I. Chelladurai, A. Orme, M.P. Miles, D.T. Fullwood, J. Carsley, R. Mishra, M. Knezevik, I. Beyerlein, S. Niezgoda (2017). Formability of Magnesium Alloy AZ31B from Room Temperature to 125°C Under Biaxial Tension. Magnesium Technology 2017, TMS Annual Meeting, San Diego, CA, pp. 661 – 668.

M.P. Miles, T.W. Nelson, F. Liu, C. Gunter, L. Fourment (2016). Simulation of Friction Stir Processing in 304L Stainless Steel. NUMIFORM 2016: The 12th International Conference on Numerical Methods in Industrial Forming Processes, MATEC Web Conf. (80) 12001, pp. 1-5.

Y.C. Lim, L. Squires, T.-Y. Pan, M. Miles, Y. Wang, Z. Feng (2015). Joining of Aluminum/ Dual Phase 980 Spot Welded by Friction Bit Joining and Weldbonding: Study of Mechanical Integrity under Corrosion Medium, Materials Science & Technology Conference, Columbus, OH, USA.

M.P. Miles, U. Karki, T. Lee, Y. Hovanski (2015). Prediction of Joint Line Movement and Temperatures in Friction Stir Spot Welding of DP 980 Steel, Friction Stir Welding and Processing VIII, TMS Annual Meeting, R. Mishra, M. Mahoney, Y.S. Sato, Y. Hovanski, 2015, pp. 229 – 240.

M.P. Miles, U. Karki, and Y. Hovanski (2014). A two dimensional axisymmetric approach to modeling of friction stir spot welding, Proceedings of NSCM-27: the 27th Nordic Seminar on Computational Mechanics, eds. Anders Eriksson, Artem Kulachenko, Mihai Mihaescu, and Gunnar Tibert, Stockholm, Sweden, pp. 188-191.

T. Ruggles, A. Khosravani, D.T. Fullwood, M.P. Miles (2014). Dislocation activity in AZ31B magnesium deformed at moderately elevated temperatures via EBSD, Magnesium Technology Symposium, TMS Annual Meeting, San Diego, CA, pp. 127 – 132.

M.P. Miles, U. Karki, C. Woodward, and Y. Hovanski (2013). Finite Element Modeling of High Speed Friction Stir Spot Welding, XII International Conference on Computational Plasticity, Fundamentals and Applications, eds. E. Onate, D.R.J. Owen, D. Peric, and B. Suarez, Barcelona, Spain, pp. 1238-1245.

Book Chapters with Peer Review

M. Miles: Formability Testing of Sheet Metals, ASM Handbook, vol. 14B, pp. 673-696 (2006). (Chapter was revised and updated)