

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

POSCO CO. LTD.,
Petitioner,

v.

ARCELORMITTAL,
Patent Owner.

Case No. IPR2025-00371
U.S. Patent No. 11,326,227

**DECLARATION OF DIERK RAABE, PROFESSOR DR.-ING.
IN SUPPORT OF PATENT OWNER'S RESPONSE**

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TABLE OF ABBREVIATIONS

Abbreviation	Description
'227	U.S. Patent No. 11,326,227
'602	U.S. Patent No. 10,961,602
Challenged Patent	'227 Patent
Cornette	Cornette et al., "High Strength Steels for Automotive Safety Parts," SAE Technical Paper Series 2001-01-0078 (2001)
Engels	Engels et al., "Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels" (2006)
GMW14400	GMW14400 Material Specification
Laurent	U.S. Patent No. 6,296,805
POSITA	Person of ordinary skill in the art
Suehiro	M. Suehiro, et al, "Properties of Aluminum-coated Steels for Hot-forming," Nippon Steel Technical Report No. 88, July 2003
Takagi	U.S. Patent Application Publication No. 2004/0009366

I. INTRODUCTION

1. I have been retained by Patent Owner ArcelorMittal as an expert in this *inter partes* review proceeding involving the Challenged Patent. I have been asked to provide my opinions relating to the patentability of the claims of the Challenged Patent, including providing opinions related to the state of the art and responding to the opinions of Dr. Miles.

2. I make the following statements based on my own personal knowledge or belief based on my expertise in the field. Below are my opinions and their underlying bases.

A. Qualifications

3. I am qualified by education and experience to testify as an expert in the fields of metallurgical science and engineering. Below, I summarize my education, qualifications, and experience, which are also summarized in my *curriculum vitae* (CV), attached as Exhibit 2020.

4. Since 2010, I have been the chief executive officer of the Max Planck Institute for Sustainable Materials (“MPIE”), formerly known as the Max Planck Institute for Iron Research, and the director of one of MPIE’s four departments: the Department of Microstructure Physics and Alloy Design. MPIE is the world’s largest and most highly cited and reputed research organization dedicated to the basic study of steels. I have been a scientific member of the Max Planck Society,

an association of German non-profit research institutes, since 1999. Prior to that, I was a scholarship-funded scientist with the Department of Materials Science and Engineering at Carnegie Mellon University and a visiting researcher at the US National High Magnetic Field Laboratory in Tallahassee, Florida.

5. I completed my education at RWTH Aachen University, from which I received my diploma (the equivalent of a Master's degree) with the highest possible distinction *summa cum laude* in 1990, doctorate with the highest possible distinction *summa cum laude* in 1992, and habilitation (the highest academic degree in Germany, equivalent to an Associate Professorship) in 1997. While completing my habilitation, I was a scientist and group leader RWTH Aachen.

6. I work in the fields of materials simulation, microstructures, and the resulting mechanical properties of metallic alloys. I work on thermodynamics and kinetics of metals as well as in alloy design, coatings, heat treatment, and metal forming. My research includes extensive investigation into the interplay between microstructural phenomena and mechanical performance of metallic systems, particularly in steels, intermetallics, multiphase alloys, and metal-matrix systems. A focus of my research approach is the combination of thermomechanical material processing, simulation, and characterization down to the atomic level.

7. With nearly four decades of experience in the field, I have expertise in, among other areas, steel-aluminum joining, interdiffusion mechanisms, and the

role of alloying elements, including in martensitic and press-hardened steels, coatings, welding, and steel design. My experience in, for example, merging phase-field simulation, thermodynamic databases, and nanoscale characterization lends to my expertise in developing predictive understandings and frameworks for reactive diffusion systems, such as those described in the patents at issue in this case (including expertise in predicting and controlling interfacial reactions between Fe and Al, and resulting diffusion kinetics, intermetallic phase transformation, and microstructural development).

8. In all, I have authored more than 700 peer-reviewed publications and seven books on materials science and engineering. My papers have been published in a number of prestigious journals, including *Nature*, *Science*, *Nature Materials*, *Nature Materials Reviews*, *Nature Communications*, and *Acta Materialia*. My work has been publicly cited over 100,000 times. According to Google Scholar, my research currently maintains an h-index rating of 189.

9. I have received six best paper awards from respected international journals for the following articles: (1) “Investigation of the orientation dependence of recovery in low-carbon steel by use of single orientation determination” in *Steel Research* 66 (1995) No.5, p. 222/29), D. Raabe; (2) “A novel roll-bonding methodology for the cross-scale analysis of phase properties and interactions in multiphase structural materials” in *International Journal of Materials Research* 106

(2015) 3-14; (3) “Autonomous Filling of Grain-Boundary Cavities during Creep Loading in Fe-Mo Alloys” in Metallurgical and Materials Transactions; (4) “Sustainable iron making towards a future circular steel economy: exploiting a critical oxygen concentration for metallurgical Cu removal from scrap-based melts” in Steel Research International - 2024 Edition Hauke Springer, Isnaldi Souza, Alisson da Silva, Ömer Büyüksulu, Dierk Raabe; (5) “On the optical spectra of hydrogen plasma smelting reduction of iron ore: application and requirements” in Steel Research International - 2024 Edition; (6) “Hydrogen-based direct reduction of iron oxide at 700°C: Heterogeneity at pellet and microstructure scales” by the International Journal of Minerals, Metallurgy, and Materials, 2022, Vol. 29, Pages 1901-1907, by Yan MA, Isnaldi Souza Filho, Xue Zhang, Supriya Nandy, Pere Barriobero-Vila, Guillermo Requena, Vogel Dirk, Michael Rohwerder, Dirk Ponge, Hauke Springer, and Dierk Raabe.

10. I have received a number of awards over the course of my career. In 2004, I received the Leibniz Prize, which is generally considered the most important research award in Germany. Twice, in 2012 and 2022, I have received a European Research Council (ERC) Advanced Grant, the largest single-researcher grant in Europe. In 2022 I received an honorary doctorate from the Norwegian University of Science and Technology. I was the recipient of the 2022 gold medal from *Acta Materialia*, a premier journal in the field of materials science. I have

also been routinely invited to give lectures at universities and research institutes around the world, including the University of Cambridge, the Chinese Academy of Sciences, the University of British Columbia, the Korea Advanced Institute of Science and Technology, Imperial College London, and Tel Aviv University.

11. Since 2011, I have been twice a member of the German Council of Science and Humanities, the main board to advise the German federal government in all fields of science and academic education, selected by the German president. I am also a member of the German National Science Academy Leopoldina, member of the US National Academy of Engineering, member of the German National Engineering Academy Acatec, member of the North Rhine- Westphalian Academy of Sciences, and Honorary Professor at the Katholieke Universiteit Leuven in Belgium. I have been a professor at RWTH Aachen as well. I have supervised more than 55 Ph.D. students and a similar number of postdocs, many of whom now are associated and full professors at universities around the world, such as at MIT, KU Leuven and RWTH Aachen.

12. My research has given me fundamental insight into the metallurgical challenges of joining steel and aluminum coating (including in achieving specific microstructural designs and controlling phase transformation). I have made foundational contributions to understanding aluminum-steel interactions, specifically in the context of hot-dip aluminizing and joining dissimilar metals.

For example, I co-authored a landmark study in *Acta Materialia* (2011) investigating intermetallic layer formation during diffusion between low-carbon steel and both pure aluminum and Al–Si alloys.¹ The research identified Al_5Fe_2 (θ -phase) as the dominant intermetallic and revealed orientation-dependent growth kinetics governed by parabolic diffusion. Crucially, the addition of Si, which was expected to retard growth based on melt experiments, instead *accelerated* reaction layer formation in solid/semi-solid regimes—contradicting conventional thermodynamic predictions and revealing the high complexity of this topic. This pioneering study illustrates my research focus on correlating thermodynamics and interdiffusion to explain phase stability and kinetics. It also provided critical insights for industrial applications such as automotive body-in-white assembly, where galvanized and aluminized coatings must use diffusion control to balance adhesion and corrosion resistance.

13. By way of another example, in a related study on laser welding of aluminum to steel, I observed the evolution of intermetallics such as Al_5Fe_2 and $\text{Al}_{13}\text{Fe}_4$ at the interface, demonstrating that morphology and layer thickness

¹ Ex. 2032 (Springer, H., Kostka, A., Payton, E. J., Raabe, D., Kaysser-Pyzalla, A., & Eggeler, G. (2011). On the formation and growth of intermetallic phases during interdiffusion between low-carbon steel and aluminum alloys. *Acta Materialia*, 59(4), 1586–1600).

correlate more strongly with peak thermal cycles than with dwell time.² These results have direct implications for designing manufacturing processes such as for resistance spot welding and hybrid bonding in vehicle lightweighting strategies (for example, in manufacturing aluminum-alloy coated hot-stamped vehicle reinforcement parts such as those relevant to the patents at issue in this case).

14. Furthermore, my research has addressed a variety of related topics in that context such as general intermetallic phase formation kinetics, solid/solid, solid/liquid, and solid/semi-solid interdiffusion effects between steel and aluminum alloys (pure Al and Al-5wt.%Si). My research has included, for example, demonstrating that η -phase (Al_5Fe_2) dominates reaction layers depending on temperature and heating rate, and grows with parabolic kinetics, indicating diffusion-controlled growth.³ My research has also addressed how to identify ternary phases (τ_6 , τ_5 , τ_1) in Fe-Al-Si systems, revealing complex interfacial chemistry.⁴ My research has also extended to Kirkendall porosity and mechanical

² Ex. 2033 (Lemmens, B., Springer, H., Duarte, M. J., de Graeve, I., de Strycker, J., Raabe, D., & Verbeken, K. (2016). Atom probe tomography of intermetallic phases and interfaces formed in dissimilar joining between Al alloys and steel. *Materials Characterization*, 120, 268–272).

³ Ex. 2034 (Lemmens, B., Springer, H., de Graeve, I., de Strycker, J., Raabe, D., & Verbeken, K. (2017). Effect of silicon on the microstructure and growth kinetics of intermetallic phases formed during hot-dip aluminizing of ferritic steel. *Surface & Coatings Technology*, 319, 104–109).

⁴ Ex. 2035 (Lemmens, B., Springer, H., Peeters, M., de Graeve, I., de Strycker, J., Raabe, D., & Verbeken, K. (2018). Deformation induced degradation of hot-dip

degradation, linking Kirkendall porosity at Al/ η -phase interfaces to embrittlement in welded steel-Al joints.⁵

15. In sum, I have deep experience in the issues and underlying science behind the patent at issue here.

B. Compensation

16. For time spent in connection with study and analysis in this matter, I am being compensated at my standard consulting rate. My compensation does not depend on my opinions or the outcome of this proceeding.

C. Materials Considered

17. I have considered all documents cited in my Report and the Miles Declaration and all documents cited therein or attached thereto.

II. LEGAL STANDARDS

18. I am not an attorney. I have been informed of and understand the following legal standards, which I understand apply in this Investigation.

A. Claim Construction

19. I understand that claim construction is a matter of law and that claim

aluminized steel. *Materials Science and Engineering: A*, 710 (July 2017), 385–391).

⁵ Ex. 2036 (Springer, H., Kostka, A., dos Santos, J. F., & Raabe, D. (2011). Influence of intermetallic phases and Kirkendall-porosity on the mechanical properties of joints between steel and aluminum alloys. *Materials Science and Engineering: A*, 528(13–14), 4630–4642. <https://doi.org/10.1016/j.msea.2011.02.057>).

terms are interpreted from the perspective of a hypothetical person of ordinary skill in the art (a “POSITA”) would understand them at the time of the invention, according to their ordinary and customary meaning in view of the patent and evidence related thereto.

B. Prior Art

20. I understand that a person shall not be entitled to a patent if the claimed invention was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public in the United States before the effective filing date of the claimed invention.

21. I understand prior art cannot anticipate or render obvious a patent claim if the alleged disclosures cited as prior art are not enabled. I understand that an enabling disclosure is a disclosure that provides sufficient detail to enable a person having ordinary skill in the art to make the claimed invention. I also understand that mere naming or description of subject matter is insufficient, if it cannot be reproduced without undue experimentation.

C. Anticipation

22. I understand that a prior art reference anticipates a patent claim if the reference discloses or includes every element of the patent claim, arranged as described in the claim in a manner that would enable person having ordinary skill in the art to practice the claimed invention. If even a single element is missing, the

prior art reference does not anticipate the patent claim.

23. An element is inherently disclosed in a prior art reference only if the missing matter is necessarily present in the thing described in the reference and would be so recognized by persons of ordinary skill. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.

D. Obviousness

24. A patent claim is invalid for obviousness if the claimed invention would have been obvious at the time the invention was made to a person having ordinary skill in the art. See 35 U.S.C. § 103. To assess obviousness, the following factors are considered: (1) the scope and content of the prior art; (2) the differences between the art and the claims at issue; (3) the level of ordinary skill in the art at the time the invention of the asserted patent was made; and (4) objective evidence of non-obviousness. To determine whether claim elements are found in the prior art, it is necessary to compare the properly construed claim language of the patent with the teachings of the prior art.

25. To combine prior art references to show obviousness, a person of ordinary skill in the art, without knowledge of the claimed invention, or without the use of hindsight, must have been motivated to combine the prior art by, for example, some suggestion or teaching in the prior art, the knowledge of one of skill in the art, or the nature of the problem to be solved. Such a person must have

had a reasonable expectation of success in doing so. It is appropriate to look to a variety of factors when evaluating reasons to combine references in an obviousness analysis. It is important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the alleged prior art elements in the manner claimed. A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art.

26. I understand that the motivation to combine must be more than a conclusory statement. That requires an adequate evidentiary basis and articulation of a reason why a person of ordinary skill in the art would combine the prior art references. That requires more than merely rejecting arguments for why a person of skill in the art would not be motivated to combine, but instead a reasoned explanation of why one of skill in the art would be motivated to combine. Common sense or common knowledge cannot be used as a substitute for reasoned analysis and evidentiary support. And relying solely on common knowledge or common sense is improper.

27. Motivation to combine requires a showing that one of skill in the art would be motivated, at the time of the invention, to have combined all references in a combination together. It is not sufficient to say that one of skill in the art could combine all references in a combination, but rather, one must show that one

of skill in the art would have combined all references in the combination.

28. It is impermissible to use the claimed invention itself as a blueprint for piecing together elements in the art. In other words, it is impermissible to use hindsight reconstruction to pick and choose among disclosures in the prior art to reconstruct the claimed invention.

E. Secondary Considerations of Non-Obviousness

29. In evaluating whether patent claims are invalid as obvious, objective indicia of nonobviousness can be considered. Such objective indicia can include: (a) commercial success of a product due to the merits of the claimed invention; (b) a long-felt, but unsatisfied need for the invention; (c) failure of others to find the solution provided by the claimed invention; (d) deliberate copying of the invention by others; (e) unexpected results achieved by the invention; (f) praise of the invention by others skilled in the art; (g) lack of independent simultaneous invention within a comparatively short space of time; and (h) teaching away from the invention in the prior art. I also understand that these objective indications are only relevant to obviousness if there is a connection, or nexus, between them and the invention covered by the patent claims.

30. I understand that a patentee is entitled to a rebuttable presumption of nexus between the asserted evidence of objective indicia and a patent claim if the patentee shows that the asserted objective evidence is tied to a specific product and

that the product is the invention disclosed and claimed. In other words, presuming nexus is appropriate when the patentee shows that the asserted objective evidence is tied to a specific product and that product embodies the claimed features, and is coextensive with them. If on the other hand, the patented invention is only a component of a commercially successful machine or process, the patentee is not entitled to a presumption of nexus.

F. Enablement of Prior Art

31. I also understand that the disclosure in asserted prior art must be adequate to enable possession of the desired subject matter. That is, the reference must teach a skilled artisan to make or carry out what it discloses in relation to the claimed invention. Thus, to render a claim obvious, the prior art, taken as a whole, must enable a skilled artisan to make and use the claimed invention. I understand that it is insufficient to name or describe the desired subject matter, if it cannot be produced without undue experimentation. I understand that the enablement inquiry takes into account what is known to a person of ordinary skill in the art. Thus, I understand that a disclosure need not include that which is already known to and available to one of ordinary skill in the art.

32. I understand that, to determine whether a prior art disclosure is enabling with reasonable (and not undue) experimentation, one may consider, among other factors, the relative skill of those in the art, the amount of direction or

guidance presented in the prior art, the quantity of experimentation necessary, the amount of direction or guidance presented, the presence or absence of working examples, the state of the prior art, the relative skill of those in the art, and the predictability or unpredictability of the art. Thus, for example, I understand that undue experimentation may be implicated and the enabling requirement not met when a disclosure provides a mere roadmap, starting point, or invitation to research without more.

III. PERSON OF ORDINARY SKILL IN THE ART (POSITA)

33. For purposes of this proceeding, I will use Dr. Miles’s description that a POSITA “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 in metallurgy.” Ex. 1003 ¶ 15.

34. I note VinFast’s technical expert at the ITC hearing, Dr. Brown, used the same articulation for a POSITA:

1. Level of Skill of a Person of Ordinary Skill in the Art

A person of ordinary skill in the art (“POSITA”) for the Asserted Patents 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 in metallurgy.” CX-0084C (Brown Rpt.) ¶ 68. ArcelorMittal has set forth a slightly

Ex. 2009 at 29.

35. However, when pressed, the POSCO and VinFast's experts took differing views on the scope of this definition. For example, Dr. Brown testified that a steel worker working on the line at a plant would qualify as a POSITA:

Q. You don't narrow or specify any specific types of metallurgical experience that would qualify someone to be a person of skill in the art of the accused patents; correct?

[Dr. Brown]. Yes. Meaning, I agree.

Q. For example, if a steel worker at a plant had an undergraduate degree in mechanical engineering and two years of experience working the line where they're melting and forming steel slabs, they would qualify as a person of skill in the art, in your view, with respect to the asserted patents; correct?

[Dr. Brown]. Yes.

Ex. 2013 at 60:18-61:4.

36. Meanwhile, Dr. Miles appeared to opine that such a person would not be a POSITA:

Q. So it's your understanding that, for example, a steelworker with a bachelor's degree in manufacturing engineering and two years of experience working with a blast furnace would qualify as a person of skill in the art in your view with respect to the '602 and the '227 patents; correct?

A. So, I guess, working in metallurgy and the way that I look at it would be not really blast furnace because that's more of an operations thing. It doesn't require, necessarily, a metallurgy background. But metallurgy would be working in the elements of metallurgy as -- as taught in a general materials science class or a metallurgy class in the areas that I talked about, so looking at microstructures, looking at heat treatments. Actually using their metallurgy background in their work.

Q. So would --

A. Melting steel doesn't require a metallurgy degree. Operating a blast furnace would be more of an operations or production-oriented thing.

Ex. 2021 at 58:1-20.

37. Although I surpass Dr. Miles's definition of POSITA now and at the priority date of the Challenged Patent, through my research and teaching, I am familiar with the knowledge and understanding of POSITA as of the priority date⁶ of the Challenged Claims, state of the art at the time, and alleged prior art cited by Dr. Miles. I have taught students with the requisite experience, and interacted with people of skill in my consulting, research project, and conference travel. I can opine on, for example, how POSITA would have understood the disclosure and claims of the Challenged Patent, the disclosures of the prior art and whether they enabled persons of skill at the time to practice or reproduce their disclosures, the state of the art and underlying science at the time, the motivation of POSITAs to combine the prior art and their likelihood of success in doing so, and what combinations would have been obvious to a POSITA.

38. As noted above, Petitioner's and the real party in interest's (VinFast's) experts disagree on type and amount of experience that a POSITA would have. But regardless, my opinions below would be the same, either applying Dr. Brown's broader view, or Dr. Miles's view of a POSITA. In either

⁶ I understand the parties do not agree on the invention date of the Challenged Claims. I understand Dr. Miles has not opined on an invention date for the Challenged Claims. In this report, if I do not specify a date, it means my opinion would be the same regardless of the invention date of the Challenged Claims.

case, as described below, as of the priority date of the Challenged Claims, a POSITA would have lacked the requisite expertise and experience necessary to form the Challenged Claims from the asserted combinations with a reasonable expectation of success and without undue (if not exceptional) experimentation.

IV. OVERVIEW OF THE ART

A. Hot Stamping

39. Hot stamping is a process used in sheet metal forming. As I explain below, “hot stamping” is used to describe the overall process (e.g., from a coil to a final part) *and* also to describe a specific step within the process (i.e., when the part is hot stamped or formed and cooled into the final part shaped). As a result, context matters when determining the meaning of the phrase “hot stamping.”

40. I understand that ArcelorMittal and VinFast jointly described the technology related to the Challenged Patent as follows:

The manufacturing process begins with the manufacturing of steel sheets. The steel sheets are then hot dipped into an aluminum or aluminum-alloy bath, which results in aluminum or aluminum-alloy coated steel, which is produced and shipped in coils.

The coils are next “hot stamped,” a process in which the steel from the coils is heated and press-hardened through die quenching. Specifically, the aluminum or aluminum-alloy coated steel coil is fed into a press and die where a blank in the desired shape is punched out from the large metal sheet. The blank is then loaded into an oven or furnace to be heated. Next, the heated blank is transferred to a hot stamping press which presses and cools the piece. Finally, the hot-stamped part is unloaded from the press for finishing.

These hot-stamped parts may form various components of an automobile, such as the frame, which includes, for example, door rings, front and rear bumper beams, door reinforcements, windscreen pillar reinforcements, A- and B-pillars, roof rails, and dash panel crossmembers. These hot-stamped parts are then assembled into automobiles.

Ex. 2022 (Joint Technology Stipulation) at 2.

41. The Challenged Patent also provides a background of the state of the art:

In recent years the use of pre-coated steels in hot-stamping processes for the shaping of parts has become important, especially in the automotive industry. Fabrication of such parts may include the following main steps:

Pre-coating of a steel sheets by hot dipping;

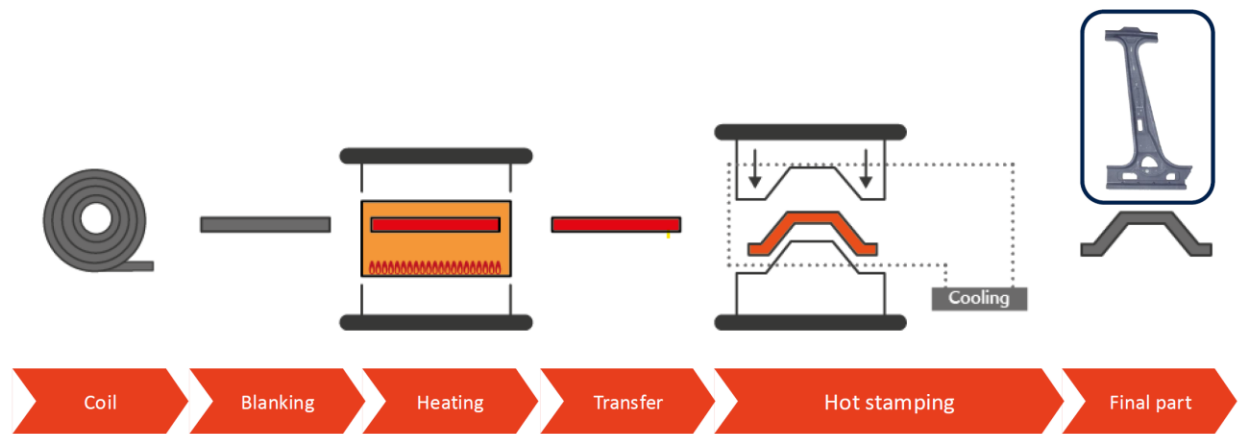
Trimming or cutting for obtaining blanks;

Heating the blanks in order to obtain alloying of the steel substrate with the pre-coating, as well as the austenitizing of the steel; and

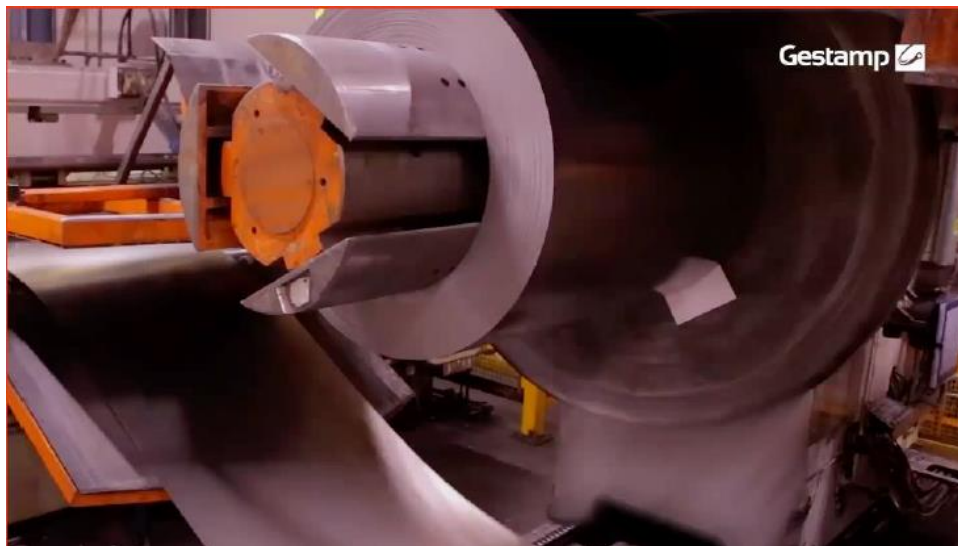
Hot forming followed by rapid cooling of the part in order to obtain predominantly martensitic structures, See for Example U.S. Pat. No. 6,296,805, incorporated herein by reference.

Ex. 1001 at 1:35-49.

42. A picture of the hot stamping process is depicted below:



43. Coil: The process typically starts with a steel coil. The coil will have a certain composition, thickness, and other features. The coil can also be uncoated or pre-coated, where the coating will also have a certain composition, thickness, homogeneity and so on. All these features can be changed or varied. Below is a picture of a coil at a factory.



44. Blanking: In the blanking step, the coil is cut so its shape is closer to the final desired shape. Below is a picture of machinery cutting the coil into blanks.



45. Heating: The next step in the process is heating the blank in an oven. During this step, the steel will undergo austenitic transformation (i.e., the iron in the base steel will undergo microstructural phase transformation to become austenitic in crystal structure, that is, having a face-centered cubic (FCC) crystal structure). This heating step is complex with multiple different parameters that interact in complex (and often unpredictable) ways to impact the structural properties of the resulting coating and base material of the final part. These parameters include the size and type of the oven and its stages (i.e., sections); the heating times, ranges, rates, and dew points at each heating stage; temperatures and temperature distributions and holding times.

46. Heating curve: This is a critical control step in the processing. For example, if heating is performed too fast, aluminum in the coating will have insufficient diffusion time to react with the base steel. This means that the melting

point of the unreacted aluminum (which is only 660°C) could be reached before necessary diffusion, resulting in liquification of the aluminum and fouling (i.e., liquid aluminum vacating the coating and fouling equipment). This depletes the aluminum available to the coating, creates waste, and fouls equipment, resulting in line downtime and repair costs. In short, the coating melts before it has time to diffuse, mix the iron, and/or transform into an intermetallic layer. This coating can also be transferred to other machinery in the process creating maintenance issues and downtime for cleaning.

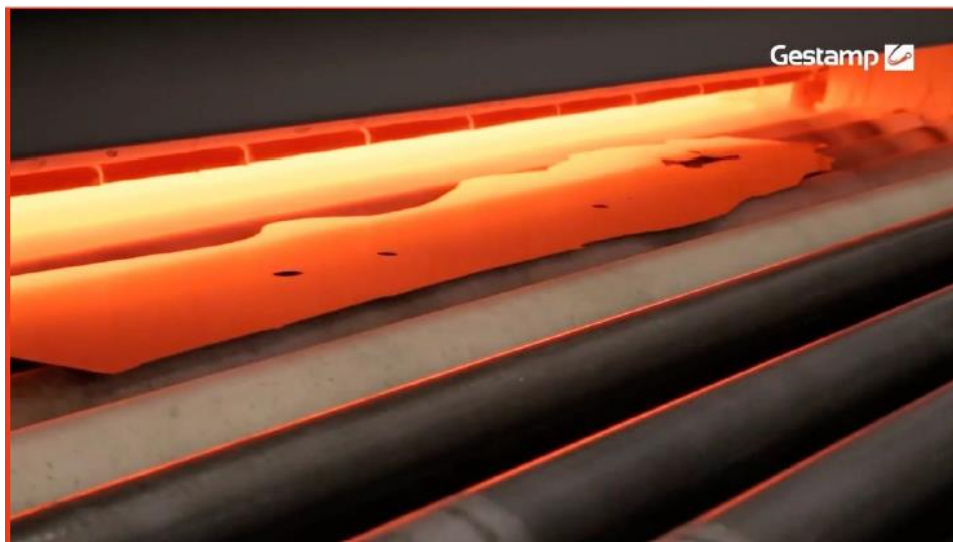
47. Likewise, if heating occurs too quickly, structured layer formation will also be inhibited. For example, the critical intermetallic phase required of the Challenged Claims may not form or remain incomplete and may not assume layered topology. Compare, for example Figure 1 in the Challenged Patents (illustrating an example of the lamellar structure required of the Challenged Claims) with Figure 2 (wherein that structure has not formed). Similarly, if heating is performed too quickly, the coating may not evenly grow leading to surface defects, cracking, and loss of corrosion protection.

48. Yet, if heating is performed too slowly, there can be excessive interdiffusion, the layered topology may be lost (as layers merge due to ongoing diffusion), the base steel could become less tough and less ductile, and there will be more oxidation. As such, longer heating can lead to disintegration of

intermediate formed lamellar structuring, increased softer diffusion zone proximate to the base steel, and resulting in loss of the layering required by the Challenged Claims (and thus loss of, for example, weldability).

49. In addition, in a manufacturing facility, the longer it takes to heat something, the longer it takes to make a part, which is more costly.

50. Below is a picture of a blank being heated on rollers in a tunnel oven.

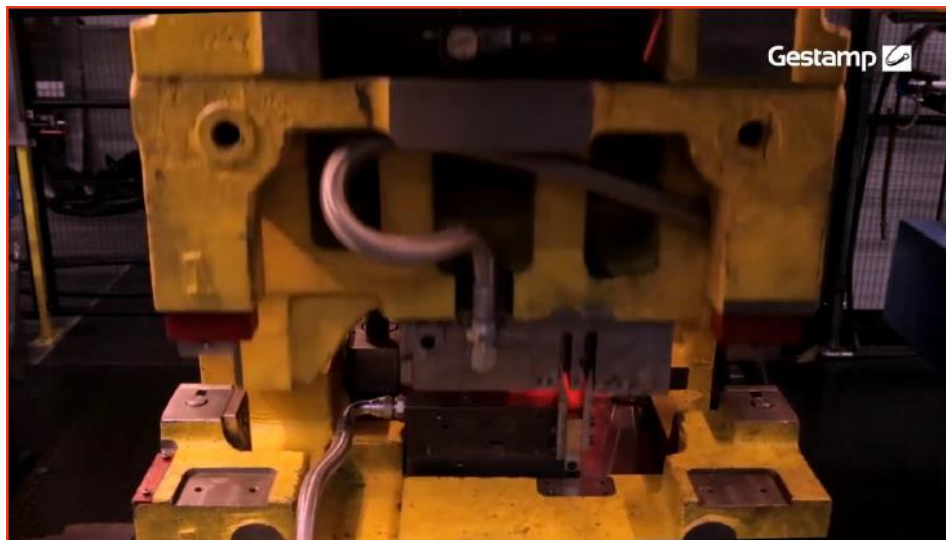


51. Transfer, Hot stamping and cooling: During these steps, the blank is transferred to the stamping part of the process and hot stamped. As I mentioned above, “hot stamping” not only can refer to the overall process but can also refer to this specific step within the overall process. The part is quenched, rapidly cooled down in temperature, and adjusted into the shape of the final desired part—often all at the same time.

52. There are many parameters that can be adjusted during these steps

including transfer time, cooling time, and exit temperature. For example, if the transfer from the oven to the press is too slow, the temperature of the part will cool before it is stamped, leading to lower hardness and strength. If the surrounding atmosphere isn't controlled, oxidation and scale can form. During stamping, cracking can form if it is not done carefully. And then in cooling step, if the cooling rate is not carefully controlled, the part may not have a martensitic transformation, leading to lower strength. Martensitic transformation occurs during quenching; thus, for the Challenged Claims, quenching must occur rapidly enough to prevent dissipation of carbon so as to result in a fully martensitic steel.

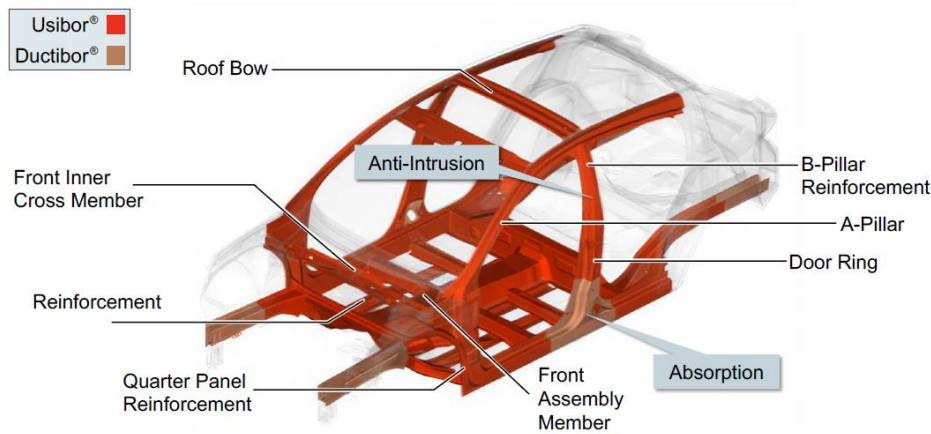
53. Below is a picture of a blank being quenched.



B. Problems with Conventional Hot Stamping

54. In the early 2000's, hot stamping was not widely used in the automotive industry. It was used in limited applications such as bumper beams, which could be bolted onto a car. Hot stamping, however, was not widely used,

for example, to make parts for the passenger cage or body-in-white (“BIW”) portion of the vehicle (the components of the vehicle shown in color below). These parts needed to be both spot welded together and must have a corrosion resistant coating, as well as must display a high degree of formability and paintability. Hot stamping parts that had these attributes posed several problems.



55. For example, the Challenged Patent describes problems associated with conventional hot stamping during the manufacturing process, specifically with the hot stamping of parts for the BIW with corrosion resistant coatings (i.e., based on aluminum alloy).

Problems however are experienced with the furnace operation: the rollers may become fouled by metallic deposits which come from the pre-coating of the blanks. If these deposits are excessive, maintenance of the rollers has to be performed and productivity is decreased.

Ex. 1001 at 1:65-2:2.

56. Dr. Drillet, one of the named inventors of the Challenged Patent, further described the problem with fouling:

So concerning the hot-stamper, as the coating has to be transformed inside the oven at a very high temperature, we have this risk to deposit a lot of liquid, and this was aluminum, mainly the aluminum coating will melt during austenization. We have to be careful not to put an excessive deposition of liquid to the surface of the rolls of the hot-stamper

Ex. 2011 at 110:19-25.

57. Another issue, as mentioned above, is that automotive manufacturers needed parts that displayed high weldability, paintability, and were corrosion resistant. Ex. 2011 at 108:3-109:3. For example, A-pillars and B-pillars are mounted using a spot-welding process, which means hot stamped parts needed to have, in addition to strong and durable corrosion resistance, the appropriate microstructure to be weldable in a “sufficiently wide operating range.” Ex. 1001 at 2:3-23; Ex. 2011 at 108:25-109:3. Yet, factors that promote corrosion resistance can reduce weldability, and vice versa, making enhancing both considerations a complex, challenging undertaking.

58. The Challenged Patent addressed these issues and more.

V. THE CHALLENGED PATENT

A. Introduction to the Challenged Patent

59. The Challenged Patent is titled “Coated steel strips, coated stamped products and methods.” Ex. 1001 at Title. The named inventors of the Challenged Patent are Pascal Drillet, Dominique Spehner, and Ronald Kefferstein.

60. The '227 Patent issued on March 30, 2021 from application number

16/413,799, which was filed on May 16, 2019. It is a continuation of application number 15/606,770, which was filed on May 16, 2017, which is a continuation of application number 13/621,015, which was filed on September 15, 2012, and issued as U.S. Patent No. 9,708,683, which is a division of application number 12/447,777, which was filed as application number PCT/IB2006/004019 on October 30, 2006, and issued as U.S. Patent No. 8,307,680

61. The Abstract of the Challenged Patent states:

A pre-coated steel strip is provided. The steel strip includes a strip of base steel having a length, a width, a first side, and a second side. The length of the strip is at least 100 m and the width is at least 600 mm. An aluminum or an aluminum alloy pre-coating is on at least part of at least one of the first or second sides of the strip of base steel. A thickness t_p of the pre-coating is from 20 to 33 micrometers at every location on at least one of the first or second sides. Processes, coated stamped products and land motor vehicles are also provided.

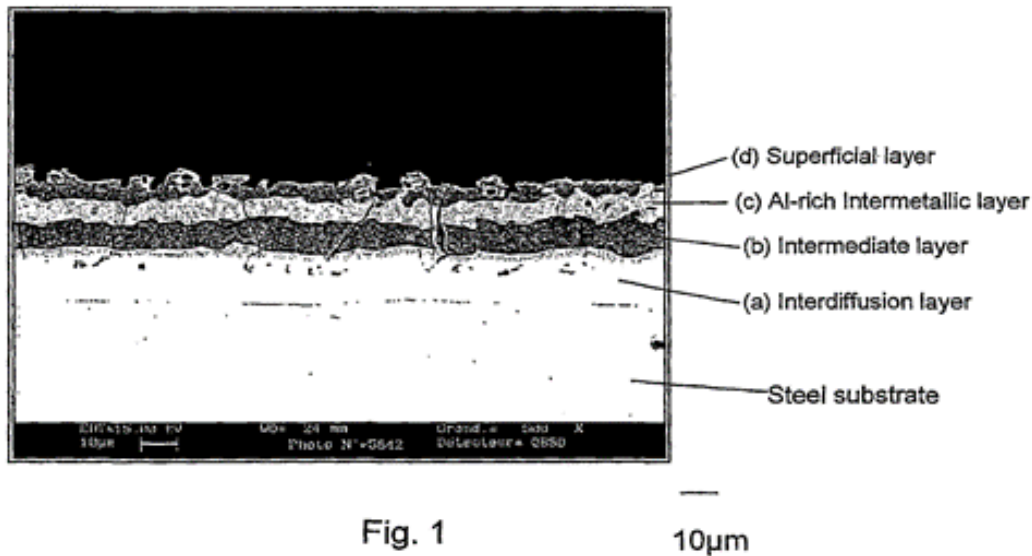
Ex. 1001 at Abstract.

62. The specification of the Challenged Patent states:

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.

63. Figure 1 of the Challenged Patent is an embodiment of the claimed invention and shows the microstructure of a hot stamped part, including the successive coating layers:



Ex. 1001 at Figure 1. These layers are the Interdiffusion layer, Intermediate layer, Intermetallic layer, and Superficial layer. Ex. 1001 at 3:54-59.

64. The Challenged Patent explains that the inventors discovered benefits to hot stamped parts with the specific claimed microstructure:

- “This arrangement is particularly favorable for the further welding of the part.” Ex. 1001 at 3:58-59.
- “The inventors have also discovered that good welding results are achieved if the coating obtained on parts made out of blanks having undergone intermetallic alloying, austenitizing and hot stamping, displays distinctive features. It must be pointed out that this 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: in this regard, the inventors have discovered that particularly good weldability of aluminized and hot stamped parts is associated with the following succession of coating layers on the parts[.]” Ex. 1001 at 6:12-23.
- “Without being bound by a theory, it is thought that this particular layer disposal, in particular layer (a) and, layers (c) and (d) influence the resistivity of the coating both by their intrinsic characteristics and by the effect of roughness. Thus, current flow, heat generation at the surfaces, and nugget

formation in the initial stage of spot welding are affected by this particular arrangement.” Ex. 1001 at 6:57-64.

- “The steel is particularly suited to the production of structural and anti-intrusion parts.” Ex. 1001 at 11:30-31.

65. Accordingly, the Challenged Patent discloses, enables, and claims a beneficial coating microstructure that is obtained in a repeatable, consistent, and robust manner. The Challenged Patent discloses process parameters that will achieve a beneficial or ideal coating microstructure in a repeatable consistent, and robust matter. See generally Ex. 1001; see also *id.* at 4:44-64; 5:12-67; 6:1-52; 6:53-7:3; 7:5-8:4; 8:5-9:20; 9:21-11:42; 11:46-14:56; 14:58-16:60; and Figures.

VI. BACKGROUND ON THE SCIENCE OF HOT STAMPING

66. As described above, the hot stamping process is a complex process with multiple different parameters that impact the properties of the final part. Ex. 2023 (“The hot stamping of Boron steel is a complex process which involves the prior plastic deformation followed by a continuous cooling transformation. The phase transformation during press hardening is affected by many factors, including material content, tool/blank interfacial contact, tool design, etc.”).

67. The relationship among all the different parameters that yield specific microstructural features of a final part is still being studied by researchers in the field today in 2025. Ex. 2024 at 10902 (“The purpose of this research is to determine the effects of heat treatment temperatures, cooling conditions, and

mechanical properties of 22MnB5 steel in detail to improve quality hot stamping parts.”).

68. In 2006, it was recognized that this process of obtaining specific microstructures (much less a multi-phasic or layered microstructure) through hot stamping was complex.

However, the multi-phase microstructure, which is at the base of the strengthening mechanisms in most of these steels, leads to unacceptably high stresses during forming and significant spring-back phenomena, thus making traditional sheet metal forming technologies unsuitable. The possibility to perform stamping operations at elevated temperatures represents a solution of these problems, allowing lower loads on tools and higher accuracy of formed components. Compared with conventional sheet metal forming, the proper design of hot stamping process chain requires the deep knowledge of both interface phenomena and material behaviour at high temperatures in order to obtain the desired properties of final products in terms of microstructure and strength characteristics.

Ex. 2025 at 396.

69. In 2006, it was also recognized how little was known about the relationship among the different parameters on the microstructure of a final part. For example, a 2006 paper in the Journal of Materials Processing Technology succinctly described the state of the art:

In the automotive industry, the hot forming of high strength steels offers the possibility to obtain significant reduction of weight without affecting the structural performances of final products. The main reason of its restricted application in the industry lies however in the ***lack of basic knowledge about mechanical and microstructural characteristics*** of sheets at elevated temperature, boundary conditions (i.e. friction and heat transfer), sensitivity of the formed component

geometrical and mechanical characteristics to all the process parameters.

Ex. 2025 at Abstract (emphases added).

70. There are many examples in the literature recognizing the complexity and lack of knowledge about how to design hot stamping processes to achieve specific microstructural properties or phase structures in steel or coatings:

- “Despite its advantages, hot stamping is a complex manufacturing process where the properties and quality of the final part are strongly affected by the material and the numerous parameters in the thermo-mechanical cycle, such as strain- and strain rate-paths, temperature and microstructure evolution that mutually interact during the forming and the cooling stages.” Ex. 2026 at 265.
- “The mechanism of formation of the layered structure is not fully evident.” Ex. 1016 ¶ 0019.
- “Despite these numerous studies of the coating, the findings of the resulting phase composition, coating/substrate interface, and void distribution in the coating are inconsistent . . . As such, this work is focused on the TEM-SAED analysis of the coating/substrate interface, and the description of phases through the coating, as well as an analysis of the top surface layer by means of XPS and roughness measurements to increase the general knowledge of Al-Si coatings.” Ex. 2027 at 3.

71. At the ITC Investigation, VinFast’s expert acknowledge that how the different parameters in the hot stamping process impact the microstructure of a part is not clear:

Q. In your view, the heating rate, the heating time, holding time, and quenching rate during hot-stamping are all process conditions that affect the result of the hot-stamped, aluminum alloy-coated steel; correct?

[VinFast’s Expert]. Well, the difficulty I have with the question is that we know that Dr. Drillet has said that those parameters are

important. I think in my deposition, I stated that I think it's not clear that how each one of those parameters affect the formation of the coating, because there hasn't been a good description in any document I've seen, other than to say that it has an influence, how that influence imposes itself, how those process conditions impose themselves in terms of forming a microstructure in the coating.

Because we've seen that it's possible to form coatings which don't have that microstructure.

And I think that there is according to the literature that I've seen, not a clear consensus in terms of precisely what set of conditions are required to produce that specific microstructure because we see that sometimes it occurs and sometimes it doesn't.

Ex. 2013 at 961:4-24 (emphasis added).

Q. In your deposition, I asked, "So, in your view, you cannot determine whether one or more of the claimed layers in the patents is present unless you know the processing conditions for the part; correct?" And you answered, "Correct." That was your testimony, right, sir, yes or no?

[VinFast's Expert]. It is.

Ex. 2013 at 962:16-22.

72. During the hot stamping process, diffusion occurs between the steel and aluminum coating. These diffusion kinetics are incredibly complex. For example, there are complex and non-linear interactions between Fe, Al, and Si. A change in the amount of any one of these elements will impact the thermodynamic and diffusional process. This is a multi-dimensional problem, where all chemical elements and all processing parameters need to be considered, rendering the intricate and often unpredictable relationships between layer composition, heating

rate, oven dwell time, layer thickness, Kirkendall porosity,⁷ mechanical properties of layers, and base sheet steel etcetera extremely hard to control and design for.

73. Adding to this already complex process, the parameters in the hot stamping process will also have an effect on the thermodynamic and diffusional process. A seemingly minor change to any variable or parameter will create complex microstructural interactions that will impact the formation of intermetallics, layer formation (or degradation), and lamellar structure and spacing.

74. For example, one of the most difficult things to control is Kirkendall porosity. Uncontrolled Kirkendall porosity is detrimental because it makes the resulting coating weaker and easier to crack. The Kirkendall effect occurs because during the heating step, Fe and Al diffuse at different rates. While this is necessary to facilitate diffusion, if this proceeds unmanaged, larger voids form than are necessary or functional to facilitate diffusion, promoting weakening in the resulting coating and/or inhibiting layer cohesion as required by the challenged claims. As a result, it is critical to manage Kirkendall porosity, although this is complicated and requires expertise. If you heat at a higher temperature and for a longer time, there

⁷ As discussed in detail below, the Kirkendall effect occurs when two metals (e.g., iron and aluminum) interdiffuse at different rates. Because the underlying lattice must remain continuous, this can result in vacancies (empty lattice sites, through which the atoms can move during diffusion). Unregulated by proper compositional and heating adjustments, this results in porosity (i.e., larger vacancies), which can ultimately result in voids in the coating that weaken the resulting product.

will be more time for phase transformation but also more time for Kirkendall porosity to occur. But if you heat a part too quickly, there may be less time for Kirkendall porosity to occur but as explained above, there may not be enough time for the coating to transform to the required phase layers.

75. Thus, correlative and interdependent factors of chemistry (e.g., coating composition), mass (e.g., coating thickness), temperature, time, heating rate and transfer time must all be managed to regulate diffusion, layer formation, intermetallic formation, and the Kirkendall effect as further discussed below (*see* Section XI.C.b.2) or the phase-defined microstructure required by the Challenged Claims cannot be obtained.

VII. OVERVIEW OF THE ASSERTED ART

A. Takagi

76. Takagi is U.S. Patent Pub. No. 2004/0009366 and is titled “Aluminum-coated structural member and production method.” Ex. 1016 at 1. The named applicants are Kiyoshi Takagi, Eizaburo Nakanishi, and Tomoyuki Yoshida. Ex. 1016 at 1.

77. Takagi is cited on the face of the ’227 Patent, which I understand indicates that the Examiner considered Takagi during the prosecution of ’227 Patent.

78. During prosecution of the related ’602 Patent, on November 25, 2019,

the applicants amended the claims in response to an office action. As part of the amendment, the applicants also explained that Takagi disclosed that the thickness of the coating layer was 10-20 μm , but it did not disclose the claim limitation requiring a coating thickness greater than 30 micrometers and further, there was no indication that if Takagi was so modified, that the layer compositions recited in the claims would be obtained.

noted that Takagi U.S. 2004/0009366 states at 0035 that: “Thickness of aluminum coating layer: 10~20 μm .” While this is the thickness of the aluminum coating before heat treatment in Takagi, there is simply no indication that the Takagi heat treatment process would increase this coating layer to meet the claim limitation of the present independent claims of claims 48, 68 and 71 of “wherein the coating has a thickness greater than 30 micrometers.” Nor, if Takagi were so modified, is there any indication that the layer compositions as claimed in claims 48, 68 and 71 would be attained.

Ex. 2016 at 50. The applicants repeated a similar statement in their April 8, 2020, response to an office action. Ex. 2016 at 38-39.

79. The abstract of Takagi provides:

(57)

ABSTRACT

An aluminum-coated structural member includes an Al—Si—Fe alloy layer formed on a steel substrate layer. The alloy layer includes a softer region having a hardness smaller than or equal to a hardness of the steel substrate layer, extends from the surface of the steel substrate layer toward a surface of the alloy layer, over a depth range greater than or equal to 50% of a thickness of the alloy layer. The Al—Si—Fe alloy layer has an oxide weight smaller than or equal to 500 mg/dm^2 .

Ex. 1016 at Abstract.

80. Takagi provides examples of aluminum-coated steel sheets. In its

examples, however, the coating layer has a thickness of 10 to 20 μm , although the exact specific coating thickness is not disclosed. Ex. 1016 at [0035]. Takagi also explains: “The mechanism of formation of the layered structure is not fully evident.” *Id.* at [0019].

81. Figure 4 of Takagi shows the “result of test 1 in the embodiment,” reciting elemental aluminum, silicon, and iron content by “composition (%)” in various “layer[s]” of the coating listed for five different experimental “examples” of results from Takagi’s “test 1.” Ex. 1016 at [0011], Fig. 4. Takagi does not, however, disclose the respective thicknesses of each various “layer.”⁸ Nor does Takagi disclose how the Figure 4 elemental data was identified. *See id.* at [0038]; *see also* [0011], Fig. 4. Takagi Figure 4 appears to be reporting the result of an SEM-EDS line scan, which, as Dr. Miles agrees, would be understood by a POSITA as limited to reporting data for one specific point or one vertical line of a cross-sectional sample:

⁸ Takagi discloses only that “Al-Si-Fe alloy layer formed on a surface of the steel substrate layer, the alloy layer including a softer region ... extending from the surface of the steel substrate layer ... and having a thickness greater than or equal to 50% of a thickness of the alloy layer.” Ex. 1016 (Takagi) at [0005]. This does not disclose the overall alloy thickness, nor the thickness of the “softer region,” nor of any layer in the coating, only that the “softer” portion predominates.

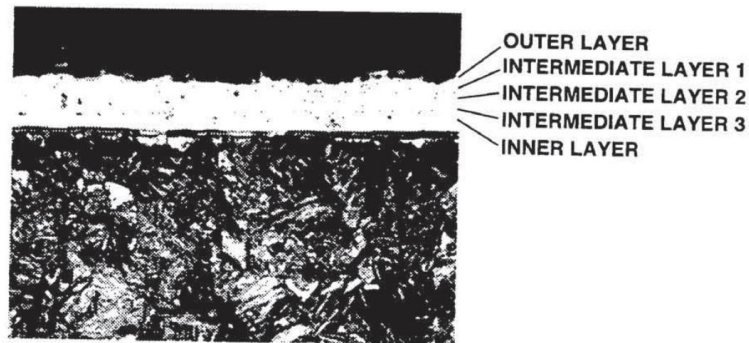
10	Q. And is that, like, a line scan?
11	A. So EDS is a line scan.
12	Q. Okay. And so that would tell you what the
13	composition is at one specific point, at one cross
14	section, if you will, or vertical line; correct?
15	A. Correct.

Ex. 2021 at 79:10-15. Takagi does not purport to disclose elemental data taken from multiple scanning locations across a sample as necessary to reflect elemental presence in more than a singular location (i.e., as necessary to characterize the existence and compositional nature of a purported coating “layer”). Thus, Takagi does not purport to (and would not be understood by a POSITA to) disclose an *average* of elemental values found in a purported layer based on multiple line scans.

82. Figure 2A of Takagi purports to disclose “a photograph showing a microstructure of a coating layer in a structural member in a practical example No. 1 in the test 1.” Ex. 1016 at [0008], Fig. 2A.

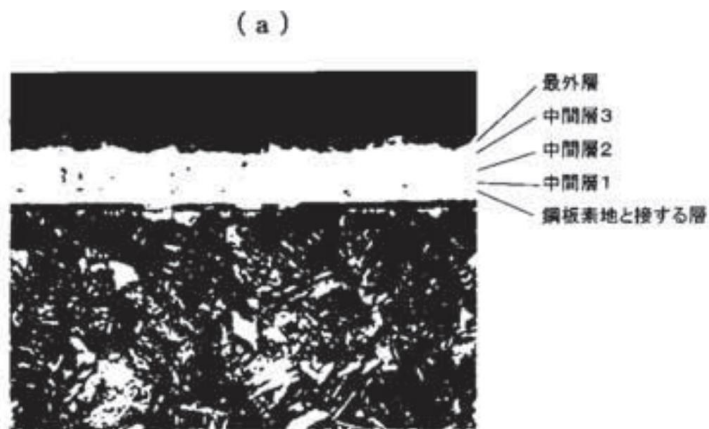
83. I excerpted Figure 2A from Takagi, both from the United States Publication and the Japanese version. In both images, the alleged layer formation is indecipherable.

FIG.2A



Ex. 1016 at Fig. 2A (US Publication).

【 図 2 】



Ex. 1017 at Fig. 2A (Japanese).

84. Dr. Miles also agreed that the purported layer structure is not discernible in Figure 2A (despite the legend stated), due to poor imaging:

13 Q. Okay. And as you point out, the -- the
 14 Figure 2A, you cannot identify discernable layers in
 15 Figure 2A; correct?
 16 A. Correct.
 17 Q. You can't identify whether there is four
 18 layers or five layers or three layers. It is just not
 19 shown visually in Figure 2A; correct?
 20 A. Correct.

Ex. 2021 at 151:13-20.

85. As noted above, Takagi also appears to disclose limited elemental spot composition data in Fig. 4/Table 1, which I have excerpted below.

FIG.4

TABLE 1

No.	PRODUCTION		COATING LAYER STRUCTURE & COMPOSITION (%)						STEEL BASE HARDNESS (Hv)	COATING LAYER HARDNESS (Hv)			OXIDE WEIGHT (mg/dm ²)	FORMABILITY	CORROSION RESISTANCE	WELDABILITY
	RAISED TEMPERATURE (°C)	HOLD TIME (min.)	COMPONENT & HARDNESS	INNER	INTER 1	INTER 2	INTER 3	OUTER		SOFTTEST	AVERAGE	SOFTER RANGE (%)				
1	920	3	Al	7.7	31.0	48.4	31.6	54.8	450	310	415	51	300	○	○	○
			Si	2.0	3.9	1.2	5.7	0.8								
			Fe	89.6	65.9	50.1	62.0	44.5								
			Hv	310	360	750	700	800								
2	900	2	Al	27.2	48.4	31.6	—	54.9	415	380	455	22	275	×	○	○
			Si	4.1	1.2	5.7	—	0.8								
			Fe	67.2	50.1	61.9	—	44.1								
			Hv	380	760	720	—	810								
3	930	10	Al	9.4	—	—	—	11.6	400	305	385	78	550	○	×	×
			Si	1.3	—	—	—	1.8								
			Fe	88.4	—	—	—	85.7								
			Hv	305	—	—	—	410								
4	950	5	Al	6.0	27.8	51.9	30.4	47.4	440	280	400	59	385	○	○	○
			Si	1.5	4.3	0.6	5.3	2.2								
			Fe	90.7	66.7	46.8	63.1	49.8								
			Hv	280	340	720	690	800								
5	900	4	Al	3.2	54.5	33.4	—	54.5	440	300	410	56	335	○	○	○
			Si	0.4	2.5	15.3	—	6.8								
			Fe	94.3	42.7	51.4	—	38.4								
			Hv	300	740	700	—	810								

Ex. 1016 at Fig. 4.

86. Table 1 contains 5 different examples. For each example, Takagi provides “coating layer structure & composition (%)” More specifically, for each of the five examples Takagi identifies a component (Al, Si, or Fe) and Hardness value (Hv) and provides one to five measurements for each component or hardness

in each of the five examples. In examples 1 and 4, Takagi provides measurements at five points: Inner, Inter 1, Inter 2, Inter 3 and Outer. In examples 2 and 5, Takagi provides measurements at Inner, Inter 1, Inter 2, and Outer. In example 3, Takagi provides measurements at Inner and Outer. For examples 2 and 5, Takagi does not explain why no measurements are provided for Inter 3.

87. Takagi does not disclose the stratification of any alleged relative coating layers or phases. In other words, it is not clear what Takagi means when it identifies something as a layer. As one example, in example No. 1 in Table 1, Takagi provides measurements for something it identifies as “outer” and “inner” coating layers, along with three “intermediate” layers. Takagi also correlates this to 5 points in an image shown in Figure 2A. But Takagi does not disclose the actual purported layers themselves, nor identify any layer as, for example, an “intermetallic layer” as required by the Challenged Patent. And Figure 2A is indecipherable making it impossible to know what exactly is being identified as a layer.

88. With respect to example Nos. 2 to 5 of Table 1, no similar photograph nor any other image data is disclosed in Takagi—photographic or SEM image data for those examples is not shown. Thus, the limited disclosure in Takagi does not allow a POSITA to confirm that the microstructural layers claimed in the Challenged Patent claims (e.g., an “intermetallic layer”) were present in any of the

five “Test 1” examples discussed in Takagi.

89. In sum, Takagi does not disclose (i) image data characterizing or showing any alleged microstructural layers in the coating, (ii) thickness or sizing data for such layers, or (iii) elemental data identifying or confirming compositional consistency necessary to characterize the formation of microstructural layers in the coating. As such, as discussed below, Takagi does not disclose enough data regarding the end/target result to enable a POSITA to scientifically replicate or confirm replication of the purported layered coating microstructure discussed in Takagi. Similarly, Takagi does not offer data or disclosure that a POSITA would understand to disclose the microstructural phase layers required and recited in the Challenged Claims.

B. Suehiro

90. Suehiro is titled “Properties of Aluminum-coated Steels for Hot-forming,” and its authors are Masayoshi Suehiro, Jun Maki, Kazuhisa Kusumi, Masahiro Ohgami, and Toshihiro Miyakoshi. Ex. 1055.

91. Like Takagi, Suehiro is cited on the face of the Challenged Patent, which I understand indicates that the Examiner considered Suehiro during the prosecution of Challenged Patent. Indeed, Suehiro was before the Patent Office during the prosecution of the Challenged Patent. Ex. 1002, 856.

92. The abstract of Suehiro provides:

Abstract

Production of parts with high strength by means of hot-forming process has been receiving considerable attention lately. Application of aluminized steel with good hardenability for this process has been investigated*. Tensile strength over than 1500MPa was obtained with steel containing around 0.2mass% C. Surface coated layer changed from Al-10% Si to Fe-Al(-Si) phases through the hot-forming process. The steel with Fe-Al(-Si) surface layer showed good paintability even without phosphatized treatment. After painting, they showed good corrosion resistance in JASO-CCT as galvanized steel did. The steel showed good spot weldability due to the stable surface layer at high temperature. (*license product within the frame of global strategic alliance with Arcelor (USIBOR1500))

Ex. 1055, Abstract.

93. Like Takagi, Suehiro provides an example of an aluminum-coated steel sheet. Figure 12 of Suehiro purports to show a micrograph of the structure of the alloy coating layer. Ex. 1055 (Suehiro) at Fig. 12 and [15]. Figure 13 purports to show the result of a line scan showing spot “SEM-EDS measurements” for Fe, Al, and Si elemental concentrations in that coating. *Id.* at Fig. 13 and [15]. Suehiro states that this “alloy phase consists of five layers, and the Al concentration changes from the topmost layer to approximately 50%, 30%, 50%, 30%, and 10%. From the fourth layer to the base layer, the element concentrations change continuously.” *Id.* at [15].

94. Suehiro does not, however, disclose test data observing any microstructural aspect constituting an “intermetallic layer” (or identifying observed intermetallics). For example, Dr. Miles testified:

21	Q. Now, once again, Suehiro doesn't refer to
22	any of the layers as being intermetallic layers;
23	correct?
24	A. I think you're correct.

Ex. 2021 at 207:21-24. Nor does Suehiro disclose the specific heating rate or curve used to obtain the final coating, stamping contact time (if any), or cooling/quenching conditions for the coated steel.

95. I have excerpted Suehiro's Figure 12 below, which shows "the alloying state after holding at 950°C for 0.5 min" (i.e., "for 30 Seconds").

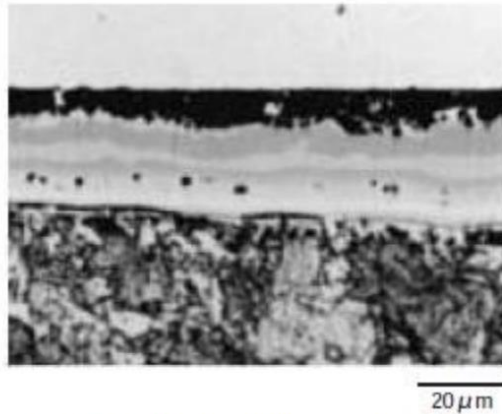


Figure 12: Cross-Sectional Optical Micrograph Showing the Structure of the Plating Layer in Sample Held at 950°C for 30 Seconds

Ex. 1055 at Fig. 12, [15]. Suehiro's Figure 15, excerpted below, shows the plating state after holding for 5 minutes:

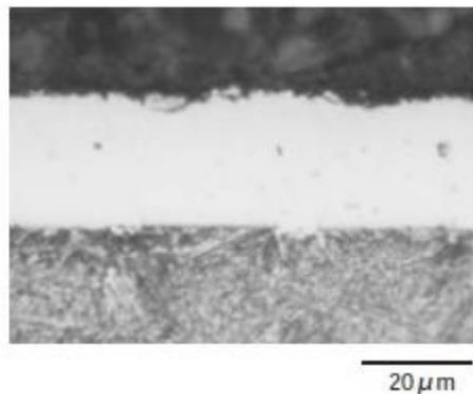


Figure 15: Cross-sectional Optical Micrograph Showing the Structure of the Plating Layer After Holding at 950°C for 5 Minutes

Ex. 1055 at Fig. 15.

96. As can be seen, increasing the holding time results in a significantly different microstructure in the coating layer (i.e., one in which the lamellar structure shown in Fig. 12 has been lost and/or transformed into a more unified structure shown in Fig. 15).

C. Cornette

97. Cornette is titled “High Strength Steels for Automotive Safety Parts” and its authors are D. Cornette, T. Hourman, O. Hudin, J.P. Laurent, and A. Reynaert of Usinor Research. Ex. 1014 (Cornette) at 1. Usinor is a predecessor to ArcelorMittal.

98. Cornette is also cited on the face of the Challenged Patent, which I understand indicates that the Examiner considered Cornette during the prosecution of the Challenged Patent. Indeed, during prosecution, the applicants explained that Cornette was asserted as an invalidating prior art reference in 683 IPR. Ex. 1002, 191.

99. The abstract of Cornette provides:

ABSTRACT

Energy savings are among the most important goals of steel users. Usinor proposes a wide range of very high strength steels (HSLA, DP, TRIP, etc.) for weight reduction and impact resistance. This text deals with the mechanical testing and different design solutions associated with these steel grades. Tensile and formability properties are presented first by means of basic tests (drawing, stretching, bending, etc.) in order to classify the different steels. A specific part of the text deals with a ultra high tensile strength pre-coated boron steel for hot forming. In addition to this, the crash resistance is investigated by using a dynamic axial compression test and a dynamic three point bending test on structural components with closed and open cross sections. For each steel grade, the estimated weight saving potential is compared with respect to parts manufactured in high drawability steel. Finally, two different designs are presented with steel solutions for safety parts. The first one shows the advantage of the use of TRIP steel and a hydroforming technique for a crash box instead of using a conventional forming technique. The second one deals with the design of a cross frontal sill with a complex cross section, formed using a profile rolling technique.

Ex. 1014 (Cornette) at 3.

100. On pages nine to 11, Cornette has a section titled “Pre-Coated Boron Steel.” Ex. 1014 (Cornette) at 9-11. In this section, Cornette describes USINOR’s development of “USIBOR” and it explains the benefits of using a pre-coated boron steel versus uncoated boron steels. Ex. 1014 (Cornette) at 9-11. For example, Cornette displays the general process for hot stamping, but other than Figure 21, does not provide any other process parameters:

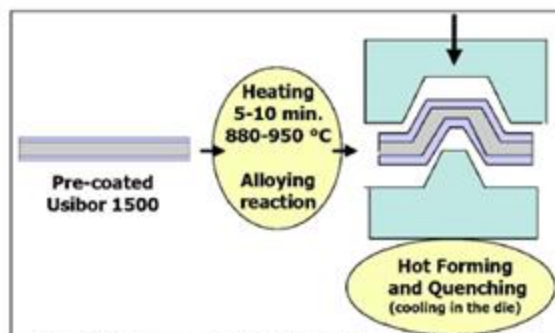


Fig. 21. Process used for the hot forming of USIBOR 1500 Pre-coated.

Ex. 1014 (Cornette) at 9.

101. Cornette also shows the chemical composition of the precoated boron steel.

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. 1014 (Cornette) at 9.

102. Cornette then provides a “Description of the Coating”:

DESCRIPTION OF THE COATING

The coating, made of aluminum and silicon, is applied with a hot dipped process.

The average layer thickness showing the best compromise between corrosion protection and weldability is 25 µm.

Heating 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.

Fe-Al-Si layer is typically about 40 µm at the steel surface. The following photo shows a section view of the coating after heat treatment:

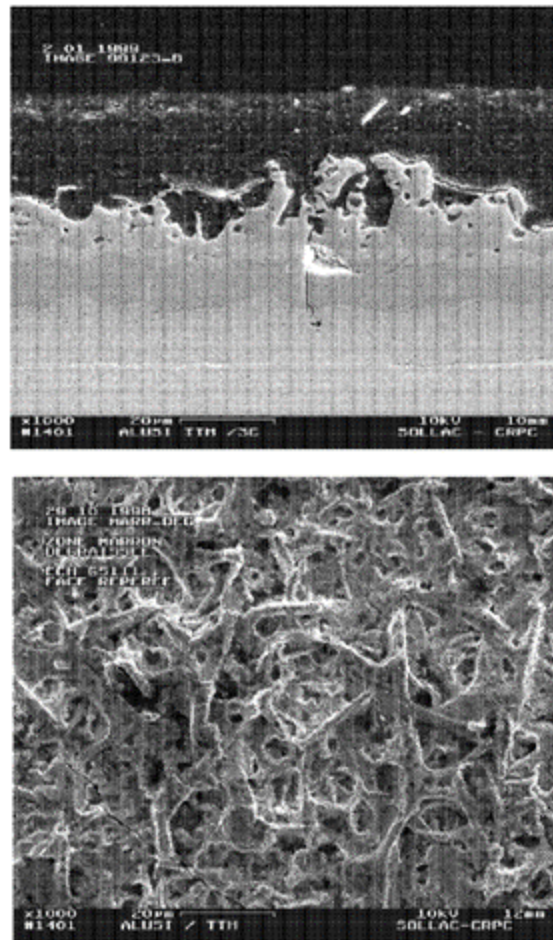


Fig. 22. Section view and coating surface after heat treatment.

Ex. 1014 (Cornette) at 9-10.

103. Cornette does not, however, provide any further analysis or description of these pictures. For example, Cornette does not indicate the composition of the coating contained in Figure 22, the thickness of the base steel used to generate Figure 22, or the specific heating curve, holding or contact time, or cool rates or times used. Nor does Cornette disclose observing any microstructural aspect constituting an “intermetallic layer” (or identifying observed intermetallics). Cornette does briefly describe “Mechanical Characteristics,” but

notes that “[m]echanical properties after hot forming process are not guarant[e]ed.”

Ex. 1014 (Cornette) at 9-11.

D. Laurent

104. Laurent is U.S. Patent No. 6,296,805 and is titled “Coated hot- and cold-rolled steel sheet comprising a very high resistance after thermal treatment.”

The named co-inventors are Jean-Pierre Laurent, Jean-Paul Hennechart, Dominique Spehner, and Jacques Devroc. It describes a steel sheet with various compositions.

105. Laurent is also cited on the face of the ’227 Patent, which I understand indicates that the Examiner considered Laurent during the prosecution of ’227 Patent. Ex. 1002, 184.

106. The abstract of Laurent provides:

(57)

ABSTRACT

Hot-rolled steel sheet which then can be cold-rolled, coated, the steel in the sheet having the following composition by 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%, the remainder being iron and impurities inherent in processing, the sheet ensuring a very high mechanical resistance after thermal treatment and the aluminum-based coating ensuring a high resistance to corrosion.

Ex. 1023 (Laurent) at Abstract.

E. Nishibata

107. Nishibata is titled “Method For Hot Forming And Hot-Formed Members.” Ex. 1050 (Nishibata) at 1. The named applicants are Toshinobu Nishibata, Masahiro Nakata, Shuntaro Suda, Akira Obayashi, and Masanobu Ichikawa. Ex. 1050 (Nishibata) at 1. Like Laurent, Nishibata describes a steel sheet with various compositions.

108. Nishibata is also cited on the face of the Challenged Patent in the form of its issued U.S. Patent (U.S. 7,559,998), which I understand indicates that the Examiner considered Nishibata’s disclosure prosecution.

109. The abstract of Nishibata provides:

(57) Abstract: A method for hot forming, wherein in the cooling step of hot pressing, a formed product is first cooled at a rate of a critical cooling rate or higher down to the Ms point thereof and then cooled at a rate of 25 to 150°C/s from the Ms point to 200°C; and a hot pressed member which has been formed by the method and has a Vickers hardness of less than (the maximum quench hardness - 10) and (the maximum quench hardness - 100) or more. The hot pressed member is manufactured from a high strength steel sheet by means of hot pressing and exhibits a stable strength and toughness in combination.

Ex. 1050 (Nishibata) at 1.

F. GMW14400

110. GMW14400 is titled “Low Carbon, Heat-Treatable Boron Steel – Uncoated or Aluminized Pre-Coated.” Ex. 1026 (GMW14400) at 1. It is a material specification from GM Worldwide Engineering Standards. Ex. 1026 (GMW14400) at 1.

111. GMW14400 is also cited on the face of the Challenged Patent, which

I understand indicates that the Examiner considered GMW14400 during the prosecution of the Challenged Patent. Ex. 1002, 236.

112. The scope of GMW14400 provides:

1 Scope

This specification covers the requirements for low carbon, heat-treatable boron steel used in the manufacture of structural parts requiring heat treatments to achieve high strength. Press-hardened steel can be pre-formed and subsequently hot-stamped and die quenched, but post-forming should not be the scope for this type of steel. Typical applications include door impact beams, bumper impact beams, and reinforcements for impact structures.

Ex. 1026 (GMW14400) at 1.

113. GMW14400 provides requirements for parts, but does not provide any process parameters for obtaining those requirements. For example, GMW14400 provides the following requirements:

Table 6: Al-Si Coating Requirements^{Note 1}

Condition	Coating Mass (g/m ²)	Coating Thickness (μm) ^{Note 2}
Prior to hot-stamping	60 to 100	20 to 33
Following hot-stamping	N/A	>35

Note 1: Additional demands can be specified by the local business units.

Note 2: Prior to hot-stamping, suitable evaluation instruments to measure coating thickness on the as-received sheet include eddy current, ferromagnetic, or microscopy. Magnetic inductive measurements are not recommended following the hot-stamping operation without proper calibration.

Ex. 1026 (GMW14400) at 7. GMW14400 does not, however, require any particular microstructural characteristics, layers, much less multiple layers, phases, or diffusion characteristics within its requirements. GMW14400 does not, for

example, require the formation of an intermetallic layer, or specify the presence of intermetallics in any way.

VIII. CLAIM CONSTRUCTION

114. “superficial layer”: Although I do not believe that Petitioner and Patent Owner dispute the plain and ordinary meaning of the “superficial layer,” as I explain below, Petitioner does not appear to apply the plain and ordinary meaning of “superficial layer” when mapping prior art to the claims. Thus, to be clear, in my opinion, a POSITA would understand that the plain and ordinary meaning of “superficial layer” is a surface or top layer. This is consistent with Dr. Miles’s view, who previously equated “superficial layer” and surface. Ex. 2028 ¶ 46. At deposition, Dr. Miles confirmed the superficial layer is the top-most layer. Ex. 2021, 120:6-8 (“Q. And the superficial layer is the top-most layer; correct? A. Yeah.”). Similarly, in the ’683 Patent IPR, Petitioner proposed that a POSITA “would have understood ‘Superficial layer’ to mean ‘a surface layer.’” Ex. 1031 at 22-24, 32. I adopt the same meaning here in my analysis.

115. “intermetallic layer”: Although Dr. Miles did not purport to offer a construction of “intermetallic layer” in his declaration in this proceeding, in the ’683 Patent IPR, Dr. Miles opined that “a PHOSITA would have understood ‘Intermetallic layer’ to mean ‘a layer composed of two or more metals or of a metal and a nonmetal in an alloy.’” Ex. 2029 ¶ 61 (relying on a general English

dictionary). At deposition in this proceeding, he repeated this same understanding of intermetallic layer. Ex. 2021 at 114:10-16 (“Would you agree that a person having ordinary skill in the art of the '602 and '227 patents would, back at the time of their priority, have understood “intermetallic layer” to mean a layer composed of two or more metals or of a metal and a nonmetal in an alloy? A. I think that's reasonable.”).

116. I disagree with Dr. Miles regarding the plain and ordinary meaning of intermetallic layer. A POSITA would not have understood “intermetallic layer” to mean “a layer composed of two or more metals or of a metal and a nonmetal in an alloy.”

117. To start, in this context (characterizing cross sections of metal coatings) a layer itself would be understood by POSITA (taking its ordinary and common usage) as a predominately lateral (i.e., horizontal on a cross-sectional SEM) stratum characterized by phase and compositional continuity—that is, a horizontal stratum with a common phase and composition. Dr. Miles and I appear to largely agree on this. Ex. 2021 at 79:25-80:3 (“You would agree that in labelling something as a layer, there would have to be some consistency across the band that we are seeing; correct? A. Yes”); 84:6-13 (“Q. You’re understanding is that a person with a skill in the art looking at these patents and how they use the term ‘layer’ would understand that to be a band of material of different

compositions, horizontal band of material of -- of consistent but different compositions from band to band; correct? A. Yeah, that would be one -- one element of how you would characterize that for sure.”).

118. As for the term “intermetallic” on its own, a POSITA would know that an intermetallic does not simply refer to the presence of two or more metals (e.g., aluminum and iron) or metalloids (e.g., silicon) merely randomly arranged relative to each other, as Dr. Miles suggests (*see* Ex. 2021 at 114:10-16, suggesting that multiple metal elements present in the same layer are sufficient to constitute an “intermetallic layer”). Rather, as POSITA would understand, an “intermetallic” is defined by those metals or metalloids being *atomically joined*. Indeed, this is consistent with several textbooks describing intermetallics. *See also* Ex. 2037; Ex. 2038 at 15 (“[I]ntermetallics form particular crystal structures with ordered atom distributions where atoms are preferentially surrounded by unlike atoms.”); Ex. 2039.

119. Taken together in an intermetallic layer, a POSITA would understand that the compounds would present in defined stoichiometric ratios and in a specific crystalline phase structure. That is, the atom types (e.g., aluminum and iron) present in specific, non-random atomic lattice positions, thereby creating a long-range ordered solid-state compound. This is distinct from less organized solid material, where the proportions of constituent elements can continuously vary over

a wider compositional range and/or can present in more heterogenous form. As a POSITA would understand, an *intermetallic layer* would present an ordered crystal structure (i.e., a crystal lattice with the different atom types sitting on specific lattice positions, creating atomic ordering) of intermetallic structure. This can be confirmed by, among other means, x-ray diffraction or electron backscatter diffraction.

120. As a result, a POSITA would understand that an intermetallic layer is “a layer containing two or more metallic (or metalloid) elements atomically joined with defined stoichiometry in an ordered crystal structure.”

121. Indeed, Dr. Miles’s view of intermetallic layer cannot be correct because it effectively renders the term intermetallic redundant or superfluous. Specifically, Dr. Miles acknowledges that under his interpretation of the plain and ordinary meaning of intermetallic layer, *every* layer is an intermetallic layer, since all the layers have “some intermetallics.”

2 Q. Let me take a step back since you referred
3 to the prior art.

4 In other words, what you're saying is that
5 the way you can identify if something qualifies as an
6 intermetallic layer in the prior art is if it's
7 essentially identified as an intermetallic layer;
8 correct?

9 A. So -- I mean, all of these layers have some
10 intermetallics. I don't know that how we label the
11 layer is important versus how we characterize it in
12 terms of composition.

Ex. 2021 at 94:2-12.

122. Thus, in my opinion, a POSITA would understand the plain and ordinary meaning of “intermetallic layer” to be “layer containing two or more metallic (or metalloid) elements atomically joined with defined stoichiometry in an ordered crystal structure.”

IX. PETITIONER’S TAKAGI BASED GROUNDS DO NOT RENDER THE CLAIMS OF THE CHALLENGED PATENT UNPATENTABLE

A. Takagi Does Not Disclose the Claimed Layers, in Particular the Intermetallic Layer

123. In my opinion, Takagi does not disclose the claimed layers, and in particular, the intermetallic layer, which is reflected in the following limitations of the Challenged Claims:

- Claim 1: “(c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron composition being higher than the second mean iron composition; and”

- Claim 21: “(c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron concentration being higher than the second mean iron composition, and”
- Claim 24: “(c) an intermetallic layer having a third mean aluminum composition different from the first and second mean aluminum compositions, and”

124. As I explained above, the plain and ordinary meaning of “intermetallic layer” is a layer containing two or more metallic (or metalloid) elements atomically joined with defined stoichiometry in an ordered crystal structure. *See supra* VIII.

125. Dr. Miles’s assessment of why Takagi discloses the claimed intermetallic layer is at paragraphs 52 to 58 of his declaration. Ex. 1003 ¶¶ 52-58.

126. First, Dr. Miles did not explain in his declaration why any specific layer in Takagi corresponds to the claimed intermetallic layer. Instead, he appears to have arbitrarily assigned disclosures in Takagi to the claimed intermetallic layer. This is demonstrated by the fact that Takagi assigns five labels: Inner, Inter 1, Inter 2, Inter 3, and Outer to the coating layer structure in its examples. Ex. 1016, Fig. 4, [0038]. However, when mapping these layers to the claimed intermetallic layer, Dr. Miles is not consistent. For tests 1 and 4, Dr. Miles alleges “Inter 3” is the intermetallic layer, but then for test 5, Dr. Miles alleges “Inter 2” is the intermetallic layer. Ex. 1003 ¶¶ 52. In other words, Dr. Miles had previously alleged that “Inter 2” was the intermediate layer in tests 1 and 4, but switch to

calling that same label “Inter 2” the intermetallic layer when it came to test 5:

10	Q.	But you do something different on
11		Embodiment No. 5?
12	A.	Right.
13	Q.	And so what was referred to previously as
14		the intermediate layer in Embodiments 1 and 4 is now
15		referred to as the intermetallic layer in Embodiment 5;
16		correct?
17	A.	Yes.

Ex. 2021 at 157:10-17. In his declaration, he did not explain why he switched from “Inter 3” to “Inter 2” and did not consistently map the intermetallic layer to a consistent disclosure in Takagi.

127. Second, Takagi does not provide enough information to determine if an intermetallic layer is present. As an initial matter, Dr. Miles concedes that Takagi does not identify any layer as an intermetallic layer.

20	Q.	Okay. So -- but my point is that Takagi
21		doesn't expressly identify any layer as an
22		intermetallic layer, per se?
23	A.	In the same way as done in the '602 patent,
24		they don't.

Ex. 2021 at 158:20-24.

128. More fundamentally, Takagi does not provide any information about the thickness of any of its layers. It also does not provide any information about how it obtained the data being shown in Table 1. For example, it is not clear if Takagi used a line scan and if the data being reported is even the mean

compositional data (as required by the claim language), as Dr. Miles agreed:

4	Q.	And we do not know how relatively large or
5		small or thin or thick those layers are; correct?
6	A.	Correct.
7	Q.	And we are not to the extent a line scan
8		was used, we are not given that line scan data here;
9		correct?
10	A.	Correct. What we may be given is
11		understood composition from a line scan, if that's what
12		they did.
13	Q.	Right. And just to clarify your testimony,
14		you said what we may be given is average compositional
15		data; correct? We don't know for sure what it is;
16		right?
17	A.	Right.

Ex. 2021 at 159:4-17.

129. Instead, to determine if Takagi disclosed an intermetallic layer, you would need at least the following: To start, one would need confirm that what is being measured in Takagi is a “layer” to begin with. As noted above, no horizontal structuring or strata is identified in Takagi Figure 2A or in any other data reported in Takagi. To the contrary, not only is this evidence of phase layering required by the Challenged Claims missing from Takagi, but the SEM that is shown in Figure 2A suggests an *absence* of multiple phase layering (at least as required by the Challenged Claims).

130. Namely, as shown in Takagi Figure 2A, black spots (i.e., Kirkendall porosity voids in the coating material) can be seen relatively evenly distributed

throughout the coating. But, in a phase layered microstructure, POSITA would expect to see an incident rate difference in Kirkendall voids from layer to layer (i.e., some layers having fewer, smaller, or almost no voids, others having more or larger voids). Here, the incident rate and distribution of Kirkendall voids scattered across the entire thickness of the coating does not indicate and instead points away from the presence of defined phase layers as required by the Challenged Claims, including indicating the absence of a defined intermetallic layer as required by the claims.

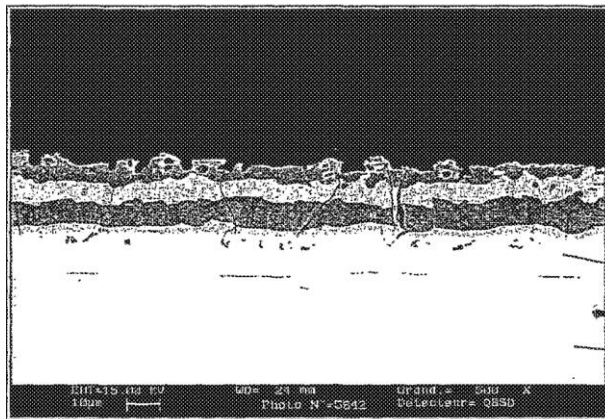
Detail of Takagi (Ex. 1016) Fig. 2A showing lack of stratification of Kirkendall voids:



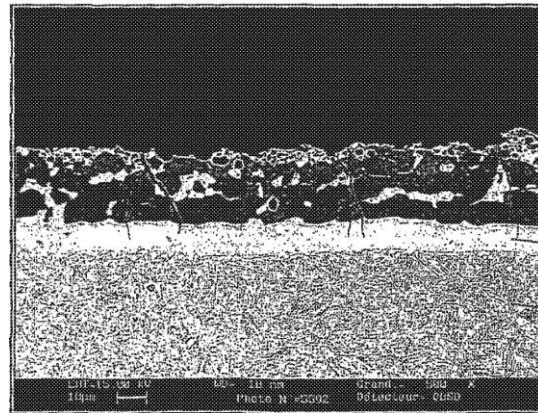
131. Moreover, the data reported in Takagi Figure 4 appears to be taken from a spot SEM-EDS (although that is not expressly stated). As POSITA would know, such a line scan would typically yield a spot size of only a few microns, and thus POSITA would know that the data reported by Takagi would only reflect elemental compositional averages for that exceedingly spot narrow line. As POSITA would understand, this is insufficient to determine whether *layers* have formed in the resulting coating as required by the Challenged Claims. It would be understood that all this would show is that there were compositional differences in

that narrow spot line extending from the base steel to the surface (not that those differences reflect a layered strata). This is illustrated in Figures 1 and 2 of the Challenged Patent here. Figure 1 “illustrates a preferred embodiment” practicing the Challenged Claims, whereas Figure 2 “a coating ... which does not correspond to the invention” (i.e., does not meet the Challenged Claims). Ex. 1001 at 3:54-64 and Figs. 1, 2:

SEM of Figure 1 (claims met)



SEM of Figure 2 (claims not met)



132. As POSITA would understand, an SEM-EDS line scan taken at any section of the coating in Figure 1 above would yield four distinct compositional zones (as the grey-scale density shown above reflects compositional differences) moving up the coating from the base steel to the coating surface. As a POSITA would also understand, a line scan from Figure 2 could *also* yield four distinct compositional values through the coating. However, as POSITA would clearly understand from Figure 2, it does not show *a layer* exhibiting atomically jointermetallic compounds with defined stoichiometry in an ordered crystal

structure (i.e., it does not show an intermetallic layer as required by the Challenged Claims). Thus, as POSITA would know, one cannot determine from a single SEM-EDS line scan whether *a layer* exists exhibiting a common compositional and/or phase characteristics. As POSITA would know, multiple measurements would need to be taken and compared to confirm the presence of a compositional phase layer, especially as here where SEM image data has not been provided (from which at least some level of compositional consistency might otherwise be identified).

133. Next, even if it were that the data reported in Takagi Figure 4 was taken from multiple line scans—which is *not* the case—and simply averaged (so as to confirm the existence of layering versus isolated pockets of compositionally-like material, as reflected in Figure 2 of the Challenged Patents), POSITA could still not confirm that the purported layer constituted an intermetallic layer as required by the Challenged Claims. While Takagi Figure 4 purports to disclose compositional data for elemental aluminum and iron (metals), as well as for silicon (a metalloid), it does not state that those elements were observed in the form of ordered intermetallic structures (i.e., atomically bound intermetallic compounds) with defined stoichiometry in a layered crystal structure.

134. To be clear, whether observed elemental aluminum, iron, or silicon have formed atomically bound intermetallic compounds—and whether those are

ordered in a defined crystal structure—can, as POSITA would know, be readily and straightforwardly determined by x-ray diffraction or electron backscatter diffraction (among other ways). But Takagi does not disclose such testing and does not disclose any such data. Thus, a POSITA would determine looking at Takagi that Takagi neither discloses nor confirms the presence of an intermetallic layer as required by the Challenged Claims.

135. Indeed, when pressed at his deposition, Dr. Miles conceded that his mapping of the claimed intermetallic layer in Takagi was based by him merely on its position relative to the surface, in light of Dr. Miles’s review of the ’227 Patent, ’227 Patent, and Cornette.

12	Q. Okay. So what you're saying is in the '227
13	and '602 and in Cornette, the intermetallic layer is
14	located directly underneath the outer or superficial
15	layer; correct?
16	A. Yes.
17	Q. So therefore when you see the layer,
18	inter 3, here that is underneath or directly below the
19	outer layer, that must be the intermetallic layer
20	because that is where it shows in Cornette and '602 and
21	'227 patent; correct?
22	A. Yeah.

Ex. 2021 at 162:12-22. That is, because Dr. Miles observed the intermetallic layer shown in Figure 1 of the Challenged Patent to be “underneath or directly below the outer layer,” Dr. Miles assumed that *any* purported layer in that same position

would constitute an intermetallic layer, without conducting any analysis as to 1) determine if sufficient data is disclosed to identify a layer in the first instance (it is not in Takagi, per above), or 2) what solid-state compounds exist in that layer and/or in what ordered crystal structure (if any). Instead, Dr. Miles assumes that any layer (if there is one) in Takagi that “underneath” the outer layer must be an intermetallic layer, which POSITA would recognize to be unscientific and insufficient in basis.

136. Dr. Miles compounds his error by relying on the alleged location of an intermetallic layer in Cornette. But for its part, Cornette never identifies any layer disclosed there as “intermetallic.” *See* EX. 1014 (Cornette) at 9-10. In fact, Cornette never identifies the elemental composition (much less characterizes any solid-state intermetallic or other compounds) in any of the strata shown in the SEM taken of the resulting coating disclosed in Cornette. *Id.* at 9. As a POSITA would recognize, Cornette thus neither discloses nor provides any data or testing to conclude that an intermetallic layer as required by the Challenged claims was present there.

137. Nor does Dr. Miles dispute this. Dr. Miles himself admitted in deposition that Cornette does not contain enough information to identify an intermetallic layer:

6	Q. But that doesn't answer the question as to
7	how we know that the lighter-colored material is
8	specifically an intermetallic layer when we have no
9	compositional data for that layer?
10	A. I don't know that from Cornette.
11	Q. Okay. So within the four corners of
12	Cornette, we cannot determine, it's fair to say, that
13	the lighter-colored material is an intermetallic layer?
14	A. Not -- not from Cornette alone we don't
15	have that disclosure.

Ex. 2021 at 191:6-15.

138. Instead, Dr. Miles asserted at his deposition that “similar compositions and thermal histories should yield similar results and correspondence with Cornette.” Ex. 2021 at 164:23-165:2. It is not clear what Dr. Miles means, however, because Takagi and Cornette do not have similar compositions or similar thermal histories. For example, Takagi has a pre-coating thickness of 10-20 μm while Cornette has a pre-coating thickness of 25 μm . Most importantly, Cornette does not disclose even disclose a heating rate. There is no way to determine if they have similar thermal histories. (And to be clear, I do not agree that “similar” histories would be enough; given the parameters and complexity in the hot-stamping process (explained above), everything would need to be the *exact* same, otherwise, the outcome will not inherently and always be the same). Thus, Dr. Miles is simply wrong that some alleged similarity means Takagi discloses an intermetallic layer.

139. In sum, Dr. Miles's view misreads the claim language at issue here. The Challenged Claims do not recite layer (a), (b), (c), and (d), where the elements of the claims can be satisfied by the mere presence of any four layers abutted to each other. Instead, the Challenged claims recite an interdiffusion layer, intermediate layer, intermetallic layer, and superficial layer separately. Each of these has a meaning to a POSITA, and Dr. Miles's analysis ignores this meaning for an intermetallic layer. Dr. Miles is simply wrong that some alleged similarity in mere location between a supposed layer in Takagi (which is not even shown there as discussed above) and the layer disclosed in the Challenged Patent means that the intermetallic layer requirement is met. As POSITA would know, that is unscientific and inaccurate.

140. As POSITA would recognize, Takagi neither confirms nor discloses the presence of an intermetallic layer, and Dr. Miles has not shown otherwise.

B. Takagi Is Not Enabled

141. In my opinion, Takagi would not have enabled a POSITA to practice or obtain the elements of the Challenged Claims for which Petitioner and Dr. Miles offer Takagi without undue and excessive experimentation.

142. Here, Petitioner and Dr. Miles posit that Takagi discloses and would allow POSITA to obtain all elements of the independent Challenged Claims except for the final requirement that overall coating thickness exceed 30 μ m. Pet. at 11;

Ex. 1003 ¶ 31. That is, Dr. Miles contends that Takagi discloses and would allow POSITA to obtain the four-layered microstructure required by the Challenged claims, save the overall thickness limitation. I disagree—Takagi would not enable or allow a POSITA to obtain or reach the four-layered microstructure required by the Challenged Claims, even exempting the thickness limitation, absent at minimum exceptional and undue experimentation involving modulation and design of multi-dimensional and complex chemical, microstructural, processing parameters.

143. As I explained above, *see supra* section VII.A, and as Dr. Miles confirmed, no purported layer structure is discernible in Figure 2A.

13	Q. Okay. And as you point out, the -- the
14	Figure 2A, you cannot identify discernable layers in
15	Figure 2A; correct?
16	A. Correct.
17	Q. You can't identify whether there is four
18	layers or five layers or three layers. It is just not
19	shown visually in Figure 2A; correct?
20	A. Correct.

Ex. 2021 at 151:13-20. Thus, Takagi does not disclose the characterization of any alleged relative coating layers or phases for POSITA to use as a guide. Takagi merely states *in text only* that its experiment resulted in a five-layer coating (not a four-layer coating). Takagi provides no guidance as to what that microstructure looked like or of its relative sizing or features. To the contrary, as also discussed

above (*see supra* section IX.A), based on the distribution of Kirkendall porosity voids throughout the coating shown in Takagi Figure 2A, a POSITA would not conclude that Takagi obtained a four phase-layered microstructure as required by the Challenged Claims at all.

144. Moreover, as also noted above (*see supra* section and IX.A), critically, Takagi does not disclose an intermetallic layer (or a basis to necessarily infer one), which is specifically required to obtain the microstructural elements of the Challenged Claims. Nor, having not disclosed one, does Takagi indicate, disclose or provide guidance on how to obtain an intermetallic layer. While Takagi does disclose some compositional data and processing conditions used in its experiments, *see* Ex. 1016 (Takagi) at [0031]-[0037], as noted above, it is not shown that those conditions obtain the layers required by the Challenged Claims, or obtain the required intermetallic layer in particular.

145. Critically, what Takagi does disclose in compositional and process data (e.g., Ex. 1016 (Takagi) at [0031]-[0037]) is insufficient for a POSITA to replicate or obtain the same result as Takagi absent more detail than what is provided (even had that result been similar to the four-layer microstructure required of the Challenged Claims, which, *per above*, is not shown by Takagi). Critically, Takagi discloses using an aluminum coating that is 10-20 μm (Ex. 1016 (Takagi) at [0035]), which reflects a 100% range in values—which POSITA would

correctly recognize as an exceedingly broad range. The diffusion kinetics that drive the achievement of the four-layered microstructure and intermetallic layer required in the Challenged Claims are mass and composition dependent (in addition to temperature and time dependent). That is, the diffusion kinetics and corresponding heating and time parameters required to obtain the four-layered microstructure and intermetallic layer required by the Challenged Claims is very, very different in a 10 μm coating than in a 20 μm coating, the latter having twice the relative mass (i.e., twice, for example, the relative aluminum) and twice the thickness (i.e., twice the distance for diffusion to be required to occur).

146. Thus, Takagi lacks a disclosure of a starting point, as the reference does not disclose how much coating is used relative to the base steel. Takagi also lacks disclosure of dew points in heating and holding, transfer times from heating to press, or details concerning the heating curve are not disclosed. See Ex. 1016 (Takagi) at [0037]. For example, target temperature in a 50C range and overall heating rate are disclosed, but a specific temperature target is not disclosed, and heating is not linear—no detailed heating stage data is provided. *See id.*

147. In short, Takagi does not disclose enough data regarding the starting point, intermediary process, or end/target result to enable a POSITA to scientifically replicate the purported coating microstructure discussed in Takagi, much less to do so in a way that meets the limitations of the Challenged Claims

(i.e., the four-layered microstructure featuring a specific, distinct intermetallic phase layer).

148. Critically here, Petitioner and Dr. Miles define a POSITA as someone who “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 in metallurgy.” Ex. 1003 ¶ 15.

149. As defined, a POSITA would have been analogous to an experienced technician working in metallurgy. A POSITA would not have been a specialist in, or even experienced with, the microstructural science of aluminum-alloy coated hot-stamped steel, or of obtaining multi-phase layered microstructural variants therein. As a result, a POSITA would not have been able to design manufacturing processes to create the claimed microstructural layers recited in the Challenged Claims using the limited disclosure in Takagi without more guidance (without at a minimum undue and excessive experimentation). Simply, Takagi does not provide sufficient characterization of the starting point or targeted layered microstructure to permit a POSITA to achieve and confirm whatever Takagi achieved (which Takagi fails to fully disclose).

150. I also attended the ITC evidentiary hearing where VinFast’s technical expert, Dr. Brown used the same definition of a POSITA that is being used in this

case. Ex. 2013 (ITC Trial) 940:2-17. As Dr. Brown stated, this definition of a POSITA is not confined to any specific type of metallurgical experience. Ex. 2013 (ITC Trial) at 940:18-22. As a result, Dr. Brown testified that an individual working at a steel plant melting and forming steel slabs would qualify as a POSITA.

[ArcelorMittal Attorney]. For example, if a steel worker at a plant had an undergraduate degree in mechanical engineering and two years of experience working the line where they're melting and forming steel slabs, they would qualify as a person of skill in the art, in your view, with respect to the asserted patents; correct?

[VinFast's Expert]. Yes.

Ex. 2013 (ITC Tr.) at 940:23-941:3.

151. Whether applying Dr. Brown's more basic view of POSITA, or Dr. Miles's slightly narrower view, the level of skill would be insufficient to arrive at the Challenged Claims or even to reach the microstructure alluded to Takagi based on the state of the art and disclosure in Takagi without undue experimentation. I have taught students with the requisite experience and also interacted with people of skill in my consulting, research projects, and conference travel that meet the definition of a POSITA for more than 35 years on several continents. And I have, likewise, interacted with many people who surpass either definition of a POSITA. The level of skill that would have been needed to design manufacturing processes exceeds both Dr. Miles and Dr. Brown's definitions of POSITA here.

152. Contrary to Dr. Miles view (or Dr. Brown's) obtaining the microstructure required by the Challenged Claims based on Takagi without the guidance of the Challenged Patent itself would have required graduate level coursework, advanced degrees, and/or significantly more experience in the field. An undergraduate degree in the recited fields and two years of experience working metallurgy would not provide someone the skill to arrive at the Challenged Claims layered elements based on Takagi's disclosures without massive, complex undue experimentation. In other words, given the advanced skill needed, it would not have been possible for a POSITA to recreate the layered, microstructural elements of the Challenged Claims, or even the microstructure alluded to in Takagi, based on the disclosure contained in Takagi and the state of the art.

153. As I explain above and below, hot stamping is a complex process with many parameters. Here, for example, a POSITA would have needed to design the heating, holding, cooling conditions, that would, during hot stamping, yield the specific phase transformation, lamellar structure, and intermetallic layering in the aluminum alloy coating as called for in the Challenged Claims, all of which would be dependent on the mass and thickness of coating (which Takagi does not sufficiently disclose). This would have been far beyond the skill of a POSITA. A POSITA would not, without excessive and undue experimentation, have been able to just take Takagi's written statement that five layers supposedly resulted in that

experiment and achieve the four-layer structure of the Challenged Claims with an intermetallic phase layered microstructure that is not shown in Takagi, all as required by the Challenged Claims.

154. Indeed, as I explained above, the diffusion kinetics and phase transformations and formations required in hot stamping is even today considered a complex, unpredictable field. Today, nearly 20 years after the Challenged Patent was invented, researchers continue to study the relationship among all the different compositional and process parameters and their interdependent impact on the development of microstructural and phase development in hot stamped coatings. Takagi would need to provide substantial guidance for obtaining the microstructural aspects of the Challenged claimed, but, as explained here, it does not.

155. During the ITC Investigation, VinFast's expert, Dr. Brown, reviewed the state of the art, including all the references asserted in this IPR. Dr. Brown stated that the art did not show a relationship among the parameters and how they impact the development of attributes in the microstructural layers.

[ArcelorMittal Attorney]. In your view, the heating rate, the heating time, holding time, and quenching rate during hot-stamping are all process conditions that affect the result of the hot-stamped, aluminum alloy-coated steel; correct?

[VinFast's Expert]. Well, the difficulty I have with the question is that we know that Dr. Drillet has said that those parameters are important. I think in my deposition, I stated that I think it's not clear

that how each one of those parameters affect the formation of the coating, because there hasn't been a good description in any document I've seen, other than to say that it has an influence, how that influence imposes itself, how those process conditions impose themselves in terms of forming a microstructure in the coating.

Because we've seen that it's possible to form coatings which don't have that microstructure.

And I think that there is according to the literature that I've seen, not a clear consensus in terms of precisely what set of conditions are required to produce that specific microstructure because we see that sometimes it occurs and sometimes it doesn't.

Ex. 2013 (ITC Tr.) at 961:4-24.

156. As I explained above, Takagi itself confirms that, at the time, “[t]he mechanism of formation of the layered structure [was] not fully evident.” Ex. 1016 at [0019]. That state of the art reflects the understanding that the hot stamping process is complex, governed by multiple interdependent and often non-linear or unpredictable factors, chemistry, and diffusion kinetics, all of which join to impact the properties of the final part. *See supra* Section VI. The (lack of meaningful) knowledge of a POSITA, the lack of clarity in the art, the complex nature and unpredictability of the art, and the (lack of meaningful) disclosure in Takagi all mean that an undue and excessive amount of experimentation in an area requiring multi-dimensional and non-linear parameters would be required to practice the Challenged Claims or create the microstructure alluded to Takagi.

157. Thus, per the reasons above, Takagi would not enable and would not allow a POSITA to obtain or achieve the microstructural elements of the

Challenged Claims that Petitioner and Dr. Miles rely on Takagi to provide to the putative combination. The generalist and basic skill in the art assigned by Dr. Miles to POSITA lacks sufficient expertise and experience to gap-fill what Takagi fails to disclose. Takagi does not provide any “direction or guidance” as to what the resulting alleged layered structure would be, nor sufficient parameters to achieve the layered microstructure recited in the Challenged Claims. While Takagi provides data for its Test 1, that data lacks working examples illustrating or evidencing a multi-layered microstructure as required by the Challenged Claims (or even as alluded to in Takagi itself). As detailed above and below (*see* sections IV, VI, and XI, *infra*), development of microstructural and intermetallic phase layering in aluminum-alloy coatings during hot stamping is exceedingly complex and involves numerous interdependent and often unpredictable factors, the kinetics and chemistry of which dynamically change from second to second during the heating, forming, and cooling process. As such, a POSITA with only ordinary skill in the field as articulated by Dr. Miles could not use Takagi to obtain the microstructure of the Challenged Claims (even without the thickness limitation) without engaging in undue and exceptional experimentation—Takagi offers at best an “invitation to research,” not even a roadmap or starting point for research (lacking, as Takagi does, any disclosure sufficiently characterizing layered microstructure).

X. PETITIONER’S SUEHIRO BASED GROUNDS DO NOT RENDER THE CLAIMS OF THE CHALLENGED PATENT UNPATENTABLE

A. Suehiro Does Not Disclose the Claimed Intermetallic Layer

158. In my opinion, Suehiro also does not disclose the following limitations of the Challenged Claims:

- Claim 1: “(c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron composition being higher than the second mean iron composition; and”
- Claim 21: “(c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron concentration being higher than the second mean iron composition, and”
- Claim 24: “(c) an intermetallic layer having a third mean aluminum composition different from the first and second mean aluminum compositions, and”

159. For much of the same reason that Takagi does not disclose an intermetallic layer as required by the Challenged Claims, neither does Suehiro. *See supra* section IV.A. POSITA reviewing Suehiro would not read it to disclose an intermetallic layer as required to form the putative combination asserted by Petitioner’s and Dr. Miles asserted grounds.

160. Unlike Takagi, Suehiro does disclose an SEM that provides indication of horizontal strata of at least some potential compositional similarity (based on the shading of the SEM). *See* EX. 1055 at [15] and Fig. 12. But like Takagi, Suehiro provides only a single line scan to identify elemental composition (in mass %) for a narrow (i.e., a few microns) vertical slice of the coating, Ex. 1055 at [15] and

Fig. 13, as Dr. Miles also confirmed. Ex. 2021 at 200:12-17. And, like Takagi, the single line scan of compositional data for elemental aluminum and iron (metals) and for silicon (a metalloid) in Suehiro (Figure 13) does not disclose whether those elements were observed as *an atomically bound intermetallic compound*. Thus, like Takagi, Suehiro does not disclose observing atomically bound intermetallic compounds of iron, aluminum, and/silicon, much less with defined stoichiometry in an ordered crystal structure as required by the Challenged Claims.

161. Thus, similar to Takagi, Suehiro provides no observed data to establish that any of the shaded areas shown in Figure 12 in fact constitutes a phase layer with an ordered crystal structure defined by intermetallic compounds. For example, like Takagi, Suehiro provides no x-ray diffraction or electron backscatter diffraction data. Given that only a single line scan is provided, like Takagi, Suehiro provides no data to even show compositional commonality across the purported strata shown in Figure 12 as needed to define a layer in the first instance as required by the Challenged Claims. As discussed above in the context of Takagi, a single line scan does not confirm compositional, or phase layering as required by the Challenged Claims. *See supra* section XI.A (discussing the differences between Figure 1 and Figure 2 of the Challenged Patent as an example).

162. Once again, Dr. Miles conceded that, in opining that an intermetallic

layer was supposedly disclosed in Suehiro, he did not engage in any scientific analysis, but rather merely relied on the location of the darker shaded zone in Suehiro's Figure 12 SEM relative to the surface of the coating (as compared to the order of coatings disclosed in the disclosed embodiment of Figure 1 in the Challenged Patent). Ex. 2021 at 209:19-211:7.

163. Even using Dr. Miles method of identifying the intermetallic layer by merely counting strata from the surface or base steel, it deserves note that Dr. Miles used an inconsistent method of identifying and characterizing purported layers in Suehiro than what he used for Takagi. In Suehiro, Dr. Miles consolidates the two purported layers closest to the base steel (shown as Nos. 4 and 5 in Suehiro Fig. 12, Ex. 1055) and treats them collectively as the diffusion layer required of the Challenged Claims. Ex. 1003 ¶ 148. In contrast, in Takagi, Dr. Miles treats the second identification of a purported layer composition ("Inter 1" in Takagi Fig. 4, Ex. 1016) as an intermediary layer required in the Challenged Claims. Ex. 1003 ¶ 52.

164. Thus, even applying his layer counting method to purportedly identify the elements of the Challenged Claims in the asserted prior art, Dr. Miles does so inconsistently, labelling in one piece of prior art (Takagi) a supposed layer as an "intermediate layer", while labelling the similarly located layer in Suehiro to be part of the "diffusion layer." Ex. 1003 ¶¶ 52, 148. Nowhere, however, does Dr.

Miles do any analysis of Suehiro to identify how or whether it actually discloses a layer exhibiting metals or metalloids atomically joined with defined stoichiometry in an ordered crystal structure (because, as a POSITA would recognize, it does not).

165. In sum, as with Takagi, Dr. Miles's view misreads the claim language at issue here. The Challenged Claims do not recite layer (a), (b), (c), and (d), where the elements of the claims can be satisfied by the mere presence of any four layers abutted to each other. The Challenged claims recite an interdiffusion layer, intermediate layer, intermetallic layer, and superficial layer separately. Each of these has a meaning to a POSITA, and Dr. Miles's analysis ignores this meaning for the intermetallic layer. Dr. Miles is simply wrong that some alleged similarity in mere location between a supposed layer in Suehiro and the layer disclosed in the Challenged Patent means that the intermetallic layer requirement is met. As POSITA would know, that is unscientific and inaccurate, as it was with Takagi above.

166. Thus, as POSITA would recognize, Suehiro neither confirms nor discloses the presence of an intermetallic layer, and Dr. Miles has not shown otherwise.

B. Suehiro Does Not Disclose the Claimed Superficial Layer

167. In my opinion, Suehiro also does not disclose the following

limitations of the Challenged Claims:

- Claim 1: “(d) a superficial layer having a fourth mean iron composition different from the third mean iron composition,”
- Claim 21: “(d) a superficial layer having a fourth mean iron composition different from the first, second and third mean iron compositions,”
- Claim 24: “(d) a superficial layer having a fourth mean aluminum composition different from the first, second and third mean aluminum compositions, the second mean aluminum composition being greater than the third mean aluminum composition;”

168. **“Superficial layer”**: As I explained above, the plain and ordinary meaning of “superficial layer” is “surface layer.” *See supra* VIII. I understand this is consistent with Petitioner’s interpretation of “superficial layer” in the *inter partes* review proceeding involving U.S. Patent No. 9,708,683. In the ’683 proceeding, Petitioner stated:

4. **“Superficial layer” (Claim 1)**

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

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

Ex. 1031 (’683 Petition) at 24.

169. In this proceeding, I understand that Petitioner has not formally requested any claim construction. At deposition, Dr. Miles confirmed that the plain and ordinary meaning of “superficial layer” is the surface or top layer.

6 Q. And the superficial layer is the top-most
7 layer; correct?
8 A. Yeah.

Ex. 2021 at 120:6-8.

170. This is also consistent with how Dr. Miles interpreted “superficial layer” in the ’683 proceeding. Ex. 2029 (Dr. Miles) ¶ 63 (“As such, in my opinion, a PHOSITA would have understood ‘Superficial layer’ to mean ‘a surface layer.’”).

171. I agree with Petitioner and Dr. Miles that the plain and ordinary meaning of “superficial layer” is a “surface layer.”

172. **Suehiro’s layer no. 1 is not a “superficial layer.”** The Petition and Dr. Miles point to a portion of the Suehiro Figure 12 as disclosing the claimed superficial layer that is not and cannot be the claimed surface layer.

173. Figure 12 is excerpted below:

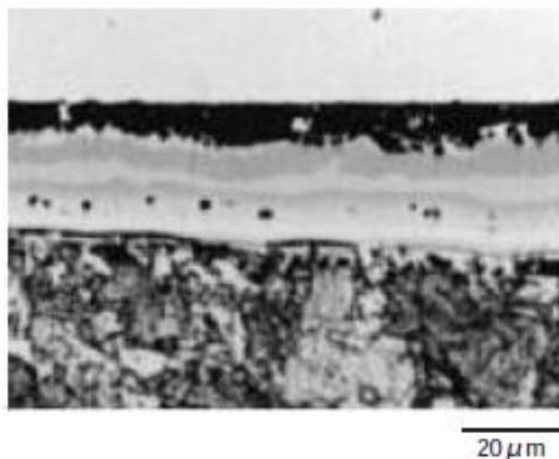


Figure 12: Cross-Sectional Optical Micrograph Showing the Structure of the Plating Layer in Sample Held at 950°C for 30 Seconds

Ex. 1055, Figure 12.

174. Figure 12 of Suehiro is a backscattered scanning electron microscopy image. And as Dr. Miles has recognized, “shading (light/dark) is reflective of the composition of the imaged material.” Ex. 2028 (Dr. Miles) ¶ 35; *see also id.* ¶ 60 (“This is evident by an examination of Engels FIG. 5, in which the lighter-colored phase 4 is entirely or essentially entirely covered by the darker phase 5.”).

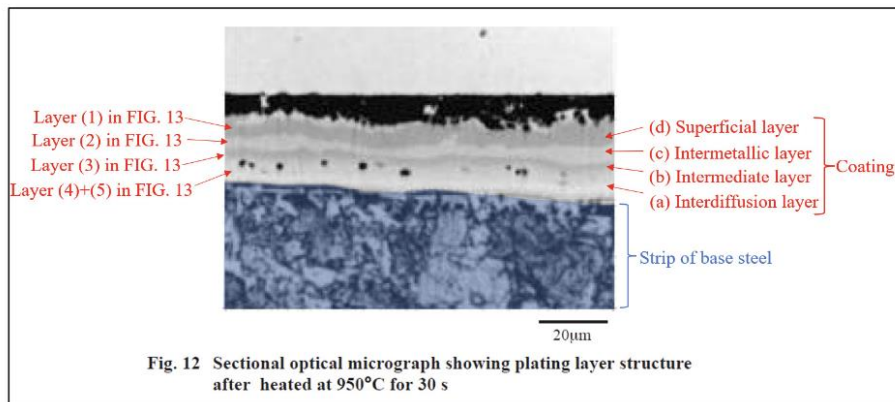
Dr. Miles uses this contrast in shading as an indication of a layer. Ex. 2028 (Dr. Miles) ¶ 53 (“In the case of FIG. 5, I measured the coating thickness based on the phase shadings, which, as I discussed above, are representative of different compositions.”); Ex. 2030 at 21 n.3 (“Dr. Miles explains that the measurement was conducted based on the shadings in FIG. 5, which, based on Engels’ disclosure and his familiarity with imaging using backscattered electrons (BSE) in scanning electron microscopy (SEM), correspond to the different phases of the coating.”).

175. To be more precise and absolutely clear, a different shading reflects that a layer has a different overall composition, but the difference in shading does not indicate how a specific element in a layer compares to that same element in a different layer.

176. I have excerpted the following from Dr. Miles’s declaration, which shows how he alleges that Suehiro discloses a “superficial layer”; all annotations were added by Dr. Miles.

148. Of the layers:

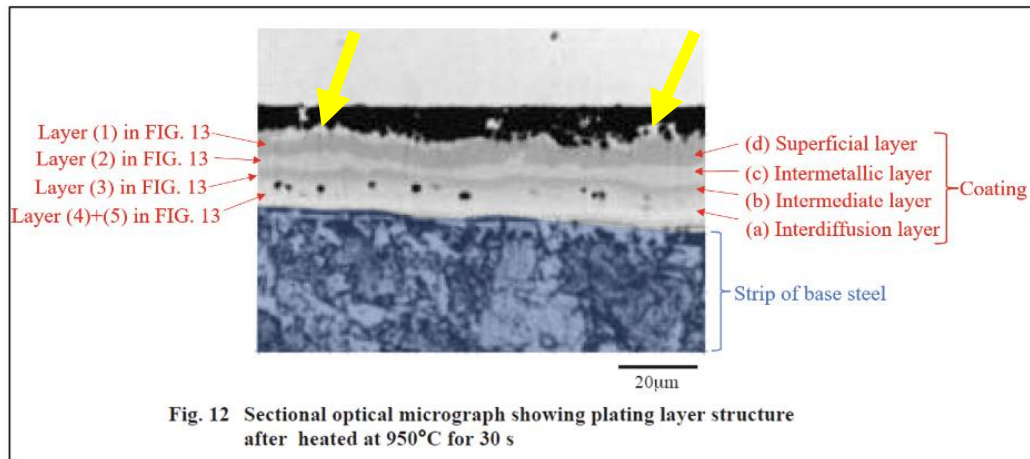
- Layer (5) (alternatively, layers (4) and (5) together) teaches layer (a) (the “interdiffusion layer”). As shown in FIG. 12, layer (5) is arranged directly on the underlying steel.
- Layer (3) teaches layer (b) (the “intermediate layer”). *Id.*
- Layer (2) teaches layer (c) (the “intermetallic layer”). *Id.*
- Layer (1) teaches layer (d) (the “superficial layer”). *Id.*



Annotated Suehiro FIG. 12

Ex. 1003 ¶ 148.

177. However, there is a layer *above* what the Petitioner identifies as the superficial layer. In Figure 12 of Suehiro, the section Dr. Miles points to as the superficial layer is not at the surface. There is another layer, indicated by a different lighter shading, above the layer in Suehiro that Dr. Miles identifies, which he expressly testified and agrees constitutes an additional layer. I added yellow arrows to Dr. Miles’s annotated version of Figure 12 to further show the presence above what Dr. Miles identifies as the alleged superficial layer.



Annotated Suehiro FIG. 12

Ex. 1003 (Dr. Miles) at ¶ 148 (adding additional annotations).

178. Figure 12 clearly shows that there is a layer above what Dr. Miles identifies as the “superficial layer” such that the phase Dr. Miles identifies cannot be the claimed “superficial layer.”

179. Indeed, Dr. Miles admitted that there is a layer above what the Petition identifies as allegedly being the claimed superficial layer.

12 Q. Okay. And then, if we look at the
13 Suehiro -- I guess you could look at your Paragraph 148
14 above. If you look at Figure 12?
15 A. Yeah.
16 Q. And you see the layer 1 is kind of a darker
17 gray layer, is that fair to say, middle, gray layer?
18 A. Yeah.
19 Q. Okay. And above that there is an
20 additional layer of lighter material; correct?
21 A. Correct.
22 Q. And that layer is not numbered or
23 identified in your annotations here to Suehiro
24 Figure 12; correct?
25 A. Correct.

Ex. 2021 at 206:12-25. Thus, what Petitioner and Dr. Miles identified as the superficial layer is not and cannot constitute the “superficial layer” required by the Challenged Claims.

XI. THERE IS NO MOTIVATION TO COMBINE EITHER TAKAGI OR SUEHIRO WITH CORNETTE OR GMW14400

180. In my opinion, a POSITA would not have been motivated to combine the aluminum alloy coating microstructure of either Takagi or Suehiro with a thicker aluminum alloy coating based on Cornette or GMW14400 with any reasonable expectation of success.

A. Dr. Miles’s Conclusion that POSITA Would Be Motivated to or Could Reasonably Make the Combination Is Speculative and Lacks Basis

181. I have, in detail, reviewed Dr. Miles’s CV, his list of publications, his experience, and his deposition testimony. While Dr. Miles is no doubt an

accomplished metallurgist in the areas of his published articles and patents, in my opinion, Dr. Miles does not have the basis to opine on the control of intermetallic phase transformation to yield specified lamellar designs or on the underlying diffusion kinetics in aluminum alloy coatings as at issue here in the Challenged Claims. In short, Dr. Miles does not appear to have expertise in the specific technical specialties at issue and driving the Challenged Claims

182. For example, Dr. Miles has not published any work or research related to fully martensitic press-hardened steel.

3	Q. Okay. But to your knowledge, you have not
4	published on work or research related to fully
5	martensitic press-hardened steel; correct?
6	A. I think that is correct.

Ex. 2021 at 32:3-6.

183. He also has never studied hot stamping parameters in combinations. Instead, he has only looked at parameters individually.

17	Q. And just for the sake of our whole
18	conversation today, when I refer to "hot stamping
19	parameters" or "requirements," you understand that I'm
20	talking about heating rates or curves, temperature
21	targets and holding temperatures, holding time,
22	stamping or contact time, cooling rates and time; is
23	that fair to say?
24	A. So I haven't studied those in these, you
25	know, kind of aggregating those in this research list.

1 If you look at those issues in some cases individually,
2 I have experience with heat treatments of steel and,
3 for that matter, heat treatments of aluminum, aluminum
4 and steel.
5 Q. Right, and I'm talking about --
6 A. And so --
7 Q. Apologies, sorry.
8 A. I was going to say the issues that I read
9 about in the '602 or the '227 patent are issues that I
10 have a good grasp of just because of my background in
11 materials science and the things that I teach in my
12 classes.
13 So I guess I would say that I feel
14 comfortable with those topics, but if you're
15 aggregating those together in a hot stamping format,
16 optimized or done parameter studies in hot stamping,
17 they are not in my list of publications.

Ex. 2021 at 32:17-33:17. As a result, he does not have the experience to opine as to changing one parameter impacts other parameters. As I explained above, hot stamping is a complex process with many interdependent parameters.

184. Dr. Miles has also not published any works on setting or experimenting with hot-stamping parameters.

3 Q. And it is accurate to say that you have not
4 published any research or work authoring setting or
5 experimenting with hot stamping parameters or
6 requirements for aluminum alloy-coated steel; correct?
7 A. Correct.

Ex. 2021 at 36:3-7.

185. Dr. Miles has also never researched working with or hot stamping aluminum alloy-coated steel.

5 Q. But your research at BYU has not involved
6 working with fully martensitic aluminum alloy-coated
7 steel; correct?

8 A. Correct.

9 Q. And your research work at BYU has not
10 involved hot stamping aluminum alloy-coated steel;
11 correct?

12 A. Correct. I want to qualify briefly. We
13 did talk about that feasibility study. And I think you
14 mentioned that was the one example where I was working
15 with a -- in a joining process working with an aluminum
16 coated hot stamped boron steel.

17 Q. Right. In that instance of the feasibility
18 study in 2017, you were not involved in hot stamping of
19 the aluminum alloy-coated steel; correct?

20 A. Correct.

21 Q. And you were not, in that feasibility
22 study, involved in designing or determining the hot
23 stamping requirements or parameters for the
24 alloy-coated steel; correct?

25 A. Correct.

1 Q. And in your research at BYU, you have not
2 been involved with experimenting with hot stamping
3 parameters or requirements for aluminum alloy-coated
4 steel; correct?
5 A. Correct.
6 Q. And in your work at -- and research at BYU,
7 you have not been involved in designing or determining
8 heating, holding or cooling parameters to obtain
9 specific layered phase structures in aluminum alloy
10 coatings for steel; correct?
11 A. Correct.

Ex. 2021 at 39:5-40:11.

3 Q. And your funded work has not involved
4 authoring or experimenting with hot stamping parameters
5 or requirements for aluminum alloy-coated steel;
6 correct?
7 A. Correct.
8 Q. And your work has not involved hot stamping
9 aluminum alloy-coated steel; correct?
10 A. Correct.
11 Q. And just to close out my questions, your
12 funded work does not involve designing or determining
13 heating, holding or cooling parameters to obtain
14 specific layered phase structured in aluminum alloy
15 coatings for steel; correct?
16 A. Correct.

Ex. 2021 at 42:3-16.

17 Q. What I mean to say is you're not doing work
18 to manufacture or form products from fully martensitic
19 steel; correct?

20 A. Correct.

21 Q. And during your work in the private sector
22 from 1995 to 2001, you were not involved in authoring,
23 setting or experimenting with hot stamping parameters
24 or requirements for aluminum alloy-coated steel;
25 correct?

1 A. Correct.

2 Q. And during your -- those years from 1995 to
3 2001, you were not involved in hot stamping aluminum
4 alloy-coated steel generally; correct?

5 A. Correct.

6 Q. And during those years, from 1995 to 2001,
7 you were not involved in designing or determining
8 heating, holding or cooling parameters to obtain
9 specific layered phase structures in aluminum alloy
10 coatings for steel; correct?

11 A. Correct.

Ex. 2021 at 45:17-46:11.

4 Q. So it would be fair to say -- let me ask
5 you this: Did -- with respect to your PhD or your
6 master's or your bachelor's degree work, you didn't
7 specifically conduct research or work with aluminum
8 alloy-coated steel; correct?
9 A. Correct.
10 Q. And with respect to your PhD, master's or
11 bachelor's you didn't conduct any work with
12 specifically hot stamping aluminum alloy-coated steel;
13 correct?
14 A. Correct, yeah. During my master's, I did
15 conduct formability testing on coated steels, but it
16 was, like, a couple of different galvanized steels and
17 the forming was at room temperature.
18 Q. Right. So you were not -- during your PhD
19 or master's or bachelor's work, you were not hot
20 stamping aluminum alloy-coated steel; correct?
21 A. Corrected.
22 Q. And during your educational work on your
23 PhD, master's or bachelor's, you were not designing or
24 setting parameters or determining the settings or
25 requirements for hot stamping processes involving

Ex. 2021 at 47:4-48:25.

8 Q. It would be fair to say that during your
9 career in education, you have not been involved in
10 setting or determining or designing or experimenting
11 with hot stamping parameters for aluminum alloy-coated
12 steel; correct?

13 A. Correct.

14 Q. And it's fair to say that during your
15 career in education, you have not operated yourself or
16 overseen the operation of hot stamping aluminum
17 alloy-coated steel; correct?

18 A. Correct.

19 Q. And it's fair to say that during your
20 career in education you have not been involved in
21 setting or determining the characteristics or
22 requirements for the base steel itself that is to be
23 coated with aluminum alloy or -- for hot stamping;
24 correct?

25 A. Correct.

1 Q. And during your career in education, you
2 have not worked on or set or determined the
3 characteristics or requirements for aluminum alloy
4 coatings for the purpose of coating steel to be hot
5 stamped; correct?
6 A. Correct.
7 Q. And during your career and education, you
8 have not been involved in setting the characteristics
9 or requirements for the aluminum alloy coatings on
10 steel after they have been hot stamped; correct?
11 A. Correct.
12 Q. And during your career in education, you
13 have not worked on a research the formation of
14 intermetallics in aluminum alloy coating on steel
15 during the hot stamping process correct?
16 A. Correct.
17 Q. And during your career and education, you
18 have not worked on or researched designing or
19 determining the heating, holding or cooling parameters
20 to determine specific phase structures in aluminum
21 alloy coatings to steel; correct?
22 A. Correct.
23 Q. And during your career and education, you
24 have not researched or worked on controlling the
25 diffusion of layered phase structures in aluminum alloy

1 coatings on steel; correct?

2 A. Correct. The only thing that I have done

3 that maybe has some relationship with what you just

4 mentioned is -- and you can decide if this is

5 relevant -- in the friction bit joining aluminum to

6 steel, as the bit is rotating rapidly, plunging through

7 the aluminum and bonding with the steel on the

8 backside, the side of the bit does react with the

9 aluminum and form an intermetallic of aluminum and iron

10 which constitutes, maybe, a secondary bonding mechanism

11 in the process. The primary one being the

12 steel-to-steel bond on the backside.

13 Q. But you have -- it is fair to say that

14 during your career in education, you have not

15 researched or been involved in studying the diffusion

16 from the base steel in -- to create layer phase

17 structures in the aluminum alloy coating on the steel,

18 the diffusion between the base steel and the coating --

19 A. Correct.

Ex. 2021 at 51:8-53:19.

186. I am confident that Dr. Miles has substantial expertise and knowledge in the field of his publications and research, namely solid-state joining (i.e., friction stir welding), forming aluminum alloys (like aluminum cans and can closures), forming magnesium alloy or stainless steel, and working with dual-phase steel or TRIP steel (TRansformation Induced Plasticity steel). But as Dr. Miles concedes, none of these areas of speciality implicate the Challenged Claims or Challenged Patent.

187. As Dr. Miles agrees, the Challenged Patent involve resistance

welding, not solid-state welding. Ex. 2021 at 26:19-22, 27:4-15, 23-25, 28:1-3. The Challenged Claims involve and require steel that undergoes multiple phase transformations during forming, which mere aluminum or magnesium alloys alone do not, nor do stainless steels or dual-phase steels undergo phase transformations or alter their crystallographic structure in forming. Ex. 2021 at 15:3-16, 16:5-9. And TRIP steel does not undergo full martensitic phase transformation nor is subject to hot forming as required by the Challenged Claims. Ex. 2021 at 20:8-11, 20:25-21:8. As Dr. Miles concedes, none of these types of steel are of the type at issue in the asserted claims. Ex. 2021 at 22:18-23:1. In fact, Dr. Miles's only work with joining press-hardened steel around 2017, over 10 years after the Challenged Claims were invented, and then only as part of a limited, unpublished feasibility study where he was working with the materials after they had been formed (i.e., not designing or supervising the hot stamping itself, or the underling steel or coatings). *See* Ex. 1021 at 13:12-19, 13:23-14:1, 31:25-32:6, 39:17-25 *see also* 10:22-23 ("I have not done traditional friction stir welding in press-hardened steel").

188. In sum, while Dr. Miles is surely experienced in his areas of expertise, those do not implicate issues or challenges or subject matter of the Challenged Claims. As noted below, Dr. Miles opines, largely by fiat, that POSITA would have been motivated to reach several combinations that purportedly would obtain the

Challenged Claims, and would do so with a reasonable chance of success using only routine experimentation. Given my experience in the subject matter at issue in the Challenged Claims, and my understanding of the level of knowledge and state of the art in the field, I do not find Dr. Miles's opinions or conclusions on these issues to be accurate or supported.

189. The subject matter of the Challenged Patent is, as I have stated here in detail, extremely complex and challenging. Dr. Miles, without direct experience in the technology at issue in the Challenged Patent, *substantially* oversimplifies the hurdles and difficulties inherent in regulating, designing, and obtaining specific phase layered microstructure via diffusion in aluminum alloy coatings. And Dr. Miles substantially aggrandizes the skill and understanding of POSITA to navigate this complex territory, in which Dr. Miles himself has little experience. Given his admitted lack of experience in the subject matter at issue in the Challenged Claims and lack of support for his positions, it is not clear what basis he has for his opinions on those issues.

B. Thicker Was Not Understood to Be Better

190. There are several reasons why a POSITA would not be motivated to increase thickness. As an initial matter, a thicker coating requires more pre-coating, which has several collateral impacts. If more pre-coating is used, manufacturing costs will increase because (1) more pre-coating will need to be

used; (2) the part will need to be in the oven longer reducing throughput; (3) there is more pre-coating that can drip or foul equipment leading to maintenance issues. All of this will significantly increase manufacturing costs and time, creating a significant pressure to avoid increasing thickness.

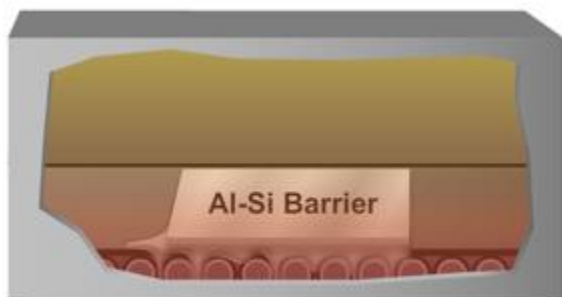
191. Indeed, in the 683 IPR, Dr. Miles reached the exact opposite conclusion he reaches now, instead opining that there would not have been an incentive to increase thickness. According to Dr. Miles in that proceeding a POSITA would instead have been motivated to *decrease* coating thickness:

19. Thus, it is clear to me that use of a thinner pre-coating would indeed result in an overall coating thickness that is greater than 30 microns and that has a layer (a) of less than 10 microns. And, as I previously explained at paragraph 164 of my declaration in Ex. 1003, known design needs would have supplied ample motivation for a PHOSITA to have routinely optimized the pre-coating thickness: “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.”

Ex. 2029 ¶ 19.

192. Dr. Miles's position in this proceeding starkly contradicts his earlier sworn declaration about thickness.

193. In addition to just manufacturing costs, using more pre-coating will create other problems during the manufacturing process that can result in damage to equipment and/or require heating lines to be shut down. For example, pre-coating is applied during a hot-dip process. To obtain a thicker pre-coating, the pre-coating aluminum immersion bath for the base steel would need to be more exacting. During the heating step, an increase in pre-coating means that there will a greater transfer of liquid to the production equipment causing fouling in the hot stamping line and related surfaces. For example, the image below is an illustration of a pre-coated steel blank being heated in an oven.



As can be seen, the coating is melting and transferring to the rollers (the piece of equipment that moves the steel blank through the oven). This will cause the liquid aluminum to foul the equipment. This results in not only materials loss, but

equipment problems and degradation, which requires production lines to be stopped to facilitate machinery repair.

194. In addition, when more coating is applied to a base steel, it becomes even more difficult to apply the coating evenly across the steel. If coating is not applied evenly or uniformly, then the diffusion layers will not form properly during the hot stamping process, which will have a detrimental effect on corrosion resistance and/or weldability.

195. Furthermore, aluminum-silicon coatings act a thermal insulator. When the aluminum-silicon coating thickness increases, then the hot stamping process becomes less efficient. For example, during the heating step, a thicker aluminum-silicon coating will increase thermal insulation and require additional design alterations to the heating curve in order to obtain the same heating and diffusion kinetics (which also results, among other things, in requiring increased temperatures and longer heating times).

196. In addition, if more pre-coating is used, the interdiffusion phase layer will be thicker and more pronounced. This creates issues with formability because there is a higher chance that the part's surface coating will crack or have other issues during the forming step.

197. All of these problems have the effect of slowing down production, increasing manufacturing time, increasing waste, increasing costs, and reducing

output. As a result, merely increasing the coating thickness would not have been commercially desirable. At that time, the state of the art would have counselled against excessive use of pre-coating.

198. Indeed, for example Takagi uses a pre-coating of only 10–20 μm . Ex. 1016, 35. And Suehiro's used a 120 g/m^2 pre-coating to obtain post-hot stamped coating that was only around 22 μm total. Ex. 1055 (Suehiro) at [11] and Fig. 13. Takagi and Suehiro did not use more pre-coating because it was not desirable to do so. Simply put, more is not always better. It was only in the Challenged Patent that the inventors set forth their specific microstructural design, wherein a microstructural intermetallic phase is developed by diffusion in the aluminum-alloy coating (which then operates to both inhibit melting and as a strength layer to promote weldability and corrosion resistance). The teachings in the Challenged Patent thus enable use of a thicker coating while addressing prior concerns with thicker coatings, thus providing a microstructural design for phase layers in aluminum-alloy coating that facilitate high weldability, high paintability, as well as avoid cracking and formation failure.

C. It Was Beyond the Ordinary Skill of a POSITA to Mix and Match Specification Criteria as Petitioner's Combination Proposes

- a. POSITA Would Not Be Motivated to Combine Takagi or Suehiro with Cornette or GMW Because They Would Know That Mixing and Matching Microstructural Features Is Unpredictable and Unreliable.**

199. With aluminum-alloy coatings, a POSITA would know that it is not possible to take a benefit from a particular microstructural design (or design aspect) and divorce it from its underlying structural limitations. One cannot, for example, take a particular microstructural phase layering resulting from one heating process, simply “make it bigger,” and then expect a coating with the same (or “better”) performance characteristics. The resulting characteristics and performance will not be the same (and may, unpredictably, be worse, even far, far worse).

200. Critical performance characteristics like corrosion resistance or weldability are not independent features separable from the layered microstructure of the aluminum-alloy coating—corrosion resistance and weldability are features that results *from* the microstructure. When the microstructure is changed—such as “made bigger” or thicker—those characteristics can change unpredictably, and not necessarily for the better.

201. Critical here, microstructural attributes that promote, for example, corrosion resistance are in tension with, if not in conflict with, attributes that promote, for example, weldability. In short, the attributes can be opposed to each other—attributes that promote corrosion resistance can inhibit weldability and vice versa. Uncoated steel is very weldable, and thickly coated steel can greatly resist corrosion. The goal is to balance the two (as the Challenged Claims do, by

enabling robust corrosion resistance while retaining weldability).

202. Thus, if someone modified the microstructure noted in Takagi or illustrated in Suehiro by making the coating 25% thicker as Dr. Miles and Petitioner propose (i.e., by combining it with the coating thickness Dr. Miles attributes to Cornette or GMW14400), then critical performance characteristics and properties would change, and not predictably or necessarily for the better. A POSITA could not just combine the processing parameters that yielded, for example, the microstructure in Takagi or Suehiro (even if known, and they are not all known) with the coating thickness Dr. Miles attributes to Cornette or GMW144000 and necessarily obtain the same or better corrosion resistant or weldability properties.

203. By way of analogy, a military plane may have excellent speed and aerodynamics, and a cargo plane may have excellent capacity, but you cannot just combine the two properties because they both involve planes. Just like you cannot take a Toyota Corolla that gets 38 miles to the gallon and replace its engine with a V8 HEMI truck engine and expect the same gas mileage (or expect the suspension, drive train, brakes, etc. to function as before). The attribute (whether speed/aerodynamics, mileage, or corrosion resistance) depends on the form and cannot be mixed and matched. Thus, a POSITA would know that, to replicate the properties noted in Takagi or Suehiro, one would need to *replicate* their

microstructure, including their respective overall coating thicknesses and subordinate relative microstructural phase thicknesses.

204. Simply upsizing the coating to be “25% bigger” as Dr. Miles and Petitioner propose would be a parameter change of exceptional magnitude that would result in substantially different resulting microstructural phase layering. To maintain the microstructural layering of Suehiro or Takagi (to the extent it could be identified in the first place) would require intricate multidimensional process design changes requiring substantial expertise and exceptional (not routine) experimentation, as detailed further below.

205. Petitioner’s and Dr. Miles’s proposed varying of 25% certainly does not constitute a small, immaterial, or minor modification. At the micrometer scale involved in hot stamping, changing the pre-coating to a thickness of 25 μm is not a “small modification” compared to the 10-20 μm range disclosed by, for example, Takagi. At that scale, this difference of 5-15 μm is very significant. Changing the pre-coating thickness from 10 μm or even 20 μm to 25 μm would as much as double (or more) the volume of coating material, giving rise to down-chain impacts on diffusion kinetics, microstructural layer formation, and the resulting properties of the hot stamped part. Consider alone that the aluminum and silicon to iron ratios would change by at least 25% to over 100% (i.e., a doubling of relative aluminum and silicon to iron), radically altering the diffusion kinetics, not to

mention that corresponding diffusion distances would increase accordingly as well. A 25-100% skew in those values would result in requiring essentially a new hot stamping parameter design, not just a minor modification as Dr. Miles presumes without basis. *See supra* sections IV, VI.

206. Indeed, Dr. Miles testified that a 25% change in the context of heating is a significant change. Ex. 2021 at 194:1-6.

207. In sum, a POSITA would know that a Frankenstein-ed microstructure that resulted from some combination of either Takagi or Suehiro combined with 25% thicker coating per Cornette or GMW14400 would have neither the structural properties or performance characteristics of Suehiro or Takagi (or of Cornette or GMW14400). Recognizing this and the inherent unpredictability involved, a POSITA would not be “motivated” to combine either Suehiro or Takagi by upsizing their coatings by 25% based on Cornette or GMW14400.

b. POSITA Would Have No Reasonable Expectation of Success in Combining Takagi’s or Suehiro’s Microstructure with Cornette’s or GMW’s Thicker Coating Absent Exceptional Undue Experimentation

208. Even if a POSITA were to attempt to “upsized” the coating in Suehiro or Takagi by 25% or more to achieve thicknesses Dr. Miles identifies from Cornette or GMW14400, while still maintaining the original purported four-layer microstructural phase layering, a POSITA would understand that doing so would require expertise beyond their level, and exceptional (not routine) experimentation.

A POSITA would simply not have a reasonable expectation of success in upsizing the coating in Suehiro or Takagi by 25% while maintaining the original microstructural features, absent exceptional non-routine experimentation.

209. This task is simply not as simple as Dr. Miles opines. Rather, it requires skilled experimental manipulation of numerous multidimensional, non-linear variables, each interrelated with the other, and management of complex, non-linear and unpredictable diffusion kinetics. In short, it requires designing a new set of hot stamping parameters to fit the new compositional, mass, and spatial relationships implicated by such a change.

210. It would have taken *substantial* expertise, experience, and extensive and undue experimentation to take the microstructure identified in either Takagi or Suehiro (to the extent so identified) and replicate it in a thicker coating form—all while still maintaining the original microstructural phase layering (or that required by the Challenged Claims). This would take far more than routine “trial and error” as Dr. Miles posits. It would require *extensive* skill and work.

1) Obtaining Specific Microstructural Architecture Across Various Coating Thicknesses Requires Modulating Numerous Interdependent and Unpredictable Nonlinear Variables

211. The science behind the hot stamping heating, holding, contact, and cooling process is complex and unpredictable. The relationship among the various parameters is still being studied today. Obtaining specific phase layering and

controlled formation and coalescence of intermetallic materials from iron diffusing into aluminum alloy is exceedingly complex and unpredictable. It is not as easy or as simply as merely isolating an attribute or variable or two and stating that it should be changed. To use another analogy, designing and controlling microstructure via diffusion kinetics to form intermetallic phase layers is not like baking a layer cake—you don't just add more batter to the pans and get the same cake, just taller subject to maybe a little extra oven time.

212. The fact that hot stamping parameters have been known does not change that the relationship among those parameters is not known. This is not the case of a finite number of possible values where results can be achieved by “trial and error” and “routine experimentation.” If that were the case, there would be little need for research in this field. Instead, there is not only an enormous range of options within each variable—e.g., an untold number of options to set heating curves alone—but that the interaction between those variables can be unpredictable. For example, Dr. Miles testified:

15	Q.	But they don't tell you any mathematical
16		relationships in order to predict diffusion or not as
17		to how predictable or unpredictable the impact of the
18		temperature variable is on the diffusion kinetics;
19		correct?
20	A.	Correct.

Ex. 2021 at 138:15-20; *see also id.* at 138:25-139:8 (temperature “does not identify how predictable or not the diffusion kinetics are”).

213. Even Dr. Brown testified to this:

Q. In your view, the heating rate, the heating time, holding time, and quenching rate during hot-stamping are all process conditions that affect the result of the hot-stamped, aluminum alloy-coated steel; correct?

[VinFast’s Expert]. Well, the difficulty I have with the question is that we know that Dr. Drillet has said that those parameters are important. I think in my deposition, I stated that I think it’s not clear that how each one of those parameters affect the formation of the coating, because there hasn’t been a good description in any document I’ve seen, other than to say that it has an influence, how that influence imposes itself, how those process conditions impose themselves in terms of forming a microstructure in the coating.

Because we’ve seen that it’s possible to form coatings which don’t have that microstructure.

And I think that there is according to the literature that I’ve seen, not a clear consensus in terms of precisely what set of conditions are required to produce that specific microstructure because we see that sometimes it occurs and sometimes it doesn’t.

Ex. 2013 (ITC Tr.) at 961:4-24.

214. Thus, while I agree that it is technically true that there are a “finite” number of ways to combine compositional elements, precoating thickness, various heating curve options, holding times, and cooling parameters, that number is incredibly large. It is similar to saying we know all the chemical elements from the periodic table and we know the way elements bond to one another; therefore, the discovery any new compound or pharmaceutical drug is nothing more than

“trial and error” and “routine experimentation.” Of course that would not be accurate. There is a lot of research that goes into, for example, pharmaceuticals despite them being all fundamentally based on the periodic table of elements.

215. Designing hot stamping parameters that manipulate diffusion kinetics to yield a particular multi-layered intermetallic microstructure in an aluminum alloy as required by the Challenged Claims is neither a one or two-dimensional exercise nor depends entirely on predictable result effective parameters.

Dr. Brown’s testimony, excerpted above, confirms this.

216. Even Takagi, relied on by Dr. Miles acknowledges this, confirming the understanding in the field at the time: “The mechanism of formation of the layered structure is not fully evident.” EX. 1016, ¶19; *see also supra* Section VI.

217. There is not a single variable (e.g., not elemental compositions, thickness or mass, heating curves, temperatures, rates, holding times, quenching parameters) that gives rise to the multi-layered intermetallic microstructure required by the Challenged Claims. Rather, the desired microstructure is the product of the complex interaction of these multiple factors, many of which themselves yield unpredictable results as they are combined as detailed here. This is why it took the inventors themselves years of extensive research to come to the inventions in the Challenged Claims.

218. For example, consider just the heating stage alone: A heating curve or

rate need not (and often is not) linear or constant—it can be (and often is) varied with time and temperature. It can be accelerated, decelerated, or held steady for any period throughout the heating stage, resulting in enormous optionality and variation. There is no set “amount” of heating that is desirable, as it is interdependent on, among other factors, the composition, mass, and the desired microstructure one is trying to obtain. The same heating curve and times can yield vastly different results (good or bad) when composition or mass are changed. This is not something that can be readily predicted; it simply has to be worked through in experimentation.

219. Moreover, in hot stamping, heating curves often are nonlinear (i.e., not defined by two points and heating rate), or even a simple curve, but can constitute a complex series of variable adjustments over the heating period. And, while such adjustments and variables affect kinetics generally, prior to the time of the Challenged Claims invention, it was not known how such adjustments affected or could be modulated to create the multi-layered intermetallic microstructure required by the Challenged Claims. *See also supra* sections IV and VI.

220. As noted above, heating must be sufficient to allow for diffusion to occur to the extent needed (and no more), for phase transformation to occur, and for the required defined intermetallic phase layer and microstructure to fully form. But, as illustrated by the difference between Figure 12 and Figure 15 in Suehiro

(*see supra* section VII.B), when heating is extended, phase and layer definition can degrade, resulting in loss of desired microstructure and thicker, more iron laden soft coatings that neither promote weldability nor are durable enough to prevent corrosion. More heating can also lead to further Kirkendall porosity voids, as noted below, which can then impair the integrity of the coating. *See also infra* section XI.A.b.

221. Likewise, holding, transfer, and contact times can all result in loss or degradation in microstructure and/or result in coatings weakened by excessive Kirkendall porosity. These stages often occur at high temperature, such that diffusion, phase transformation, and underlying changes to microstructure are continuing to occur. Cooling or quenching must then be fast enough to obtain a full martensitic transformation without allowing time for carbon to diffuse out of the steel, while not being so fast that the part becomes subject to internal stresses that can result in, for example, cracking.

222. Furthermore, all of the above factors are interdependent with composition and mass. Changes in overall mass, including, for example, relative mass of aluminum or silicon, caused by adding layer thickness necessarily then affects all other variables.

2) Obtaining Specific Microstructural Architecture Across Various Coating Thicknesses Requires Controlling Exceedingly Complex Nonlinear Diffusion Kinetics

223. In sum, not only is the relationship among variables highly complex, but the impact these variables have on diffusion kinetics is unpredictable. As Dr. Miles admitted in his deposition, “during diffusion and phase transformations, the material at issue is literally changing composition and phases dynamically in time such that the material is not the same from one moment to the next.” Ex. 2021 at 231:3-8. As Dr. Miles also concedes, this presents a multidimensional problem involving interdependencies that are not linear ,and where those interdependencies change over time as the process unfolds. *See id.* at 231:15-232:2.

224. And those diffusion kinetics must be managed to obtain the layered intermetallic microstructure required by the Challenged Claims. Failure to carefully design hot stamping parameters that properly control diffusion kinetics will result in coating failures. And this management requires expertise and experience far beyond that of the ordinary POSITA as defined by Petitioner and Dr. Miles. Managing these diffusion kinetics in an interdependent nonlinear multivariable system is far from the “routine” task that Dr. Miles assumes (and assumes without basis).

225. To start, diffusion kinetics will be substantially affected and altered when material thickness is altered (i.e., when coating thickness is altered). Whatever parameters give rise to, for example, a four-layered intermetallic microstructure yielding a 25 μm coating, will not result in the same diffusion

kinetics or yield the same microstructure in a thicker or thinner coating. And as noted above, a 25% proposed increase is a substantial change that will yield substantial changes in the resulting diffusion kinetics.

226. Thus, to achieve the purported combination here, it is not as easy as increasing the thickness of the coating and saying do not change anything else (beyond enlarging things). The specification designer must instead redesign the other parameters to again achieve the targeted microstructure under different diffusion kinetics in a different material thickness. As I explained above, at the time of the invention, it was not understood in the field as to how exactly how these variables could be modulated to achieve that result. *E.g.*, Ex. 1016 (Takagi) at [0019]. Even now in 2025, there is still research being conducted into the relationship among these variables.

227. In my opinion, at best, Petitioner's combination is nothing more than an invitation to experiment. This does not mean, however, that a POSITA would have had a reasonable expectation of success in that experiment, absent undue and excessive experimentation (e.g., plugging and chugging through countless variations of parameters in hopes of happening upon the right diffusion kinetics to yield the Challenged Claims).

228. As noted above, a POSITA does not have requisite level of skill to designing hot stamping parameters to obtain particular multi-layered intermetallic

phases in aluminum alloy via diffusion kinetics. It would take significant adjustments to the process in light of the issues outlined above, such that it would require much more than just trivial adjustments to a hot stamping process (and beyond their experience). For the reasons I have explained above, I do not agree that the proposed adjustments to Takagi or Suehiro to obtain thicker coatings attributed to Cornette or GMW14400 would have been within the skill of a POSITA or would have been achievable with a reasonable expectation of success.

229. For example, Dr. Miles provides no evidence about how a longer formation time required for thicker coatings and layers impacts the elemental composition of these layers (or the correlative formation of intermetallic compounds). As heating time increases and layers grow thicker, more diffusion occurs and the elemental composition of each layer changes. The diffusion kinetics affected by changes in the heating curve implicated in attempting a thicker coating can then affect the coalescence of, or give rise to the degradation of, the desired phase layers (as shown, for example, in Suehiro (Ex. 1055) at Figure 15).

230. As noted above, the longer formation time also raises substantial challenges with Kirkendall porosity, the kinetics and distribution of which must *additionally* be managed. The Kirkendall effect is a necessary and inherent phenomenon created when two metals that are in contact diffuse into each other at different rates—here, aluminum diffusing downward quickly, iron diffusing

upward much, much more slowly. Because the lattice must remain continuous, this imbalance leaves a flux of vacancies (i.e., empty lattice sites) through which atoms can move and change positions (i.e., through which diffusion can be further accomplished). If unmanaged, if these vacancies occur faster than they can be absorbed by, for example, atomic line defects called dislocations or grain boundaries, they accumulate and condense into voids or pores (i.e., Kirkendall porosity). These voids (shown in SEM images such as Takagi (Ex. 1016) Figure 12 as black dots in the coating) are not caused by gas; they are a crystallographic signature of imbalanced atomic fluxes from diffusion.

231. As noted above, a coalescence or prevalence of Kirkendall porosity can result in coating failure and thus must be managed. In iron-aluminum systems like the subject of the Challenged Claims, a 25% increase in coating thickness and mass, with corollary changes in ratios of iron to aluminum and silicon, would result in substantially different diffusion kinetics and thus substantially different potential for Kirkendall porosity. Thus, two systems would need to be managed simultaneously—(i) adjustments in parameters to achieve the same microstructure in a thicker coating and (ii) adjustments necessary to control Kirkendall porosity under new kinetics.

232. These two goals can, however, be in conflict, with the longer heating state required to direct diffusion through thicker material promoting more

Kirkendall voids. That is, the heating curves and times required to form, for example, the intermetallic layer of the Challenged Claims will also amplify Kirkendall porosity if not properly managed. It takes substantial experience, massive experimental effort, and substantial time and research to thread these competing needs. Complex variations in temperature, time, heating rates transfer rates, and composition are required. For example, ratios of silicon may be adjusted to, in part, reduce Kirkendall porosity. Silicon ratios are determined, however, by the coating composition, such that this adjustment can require changing the compositional formulation of the coating. That is, to manage Kirkendall porosity, it may not be feasible to use the same compositional formulation for a 10 or 15 μm precoating as for a 25 μm precoating.

233. Dr. Miles does not address any of the above and does not even mention the challenges with Kirkendall porosity (much less opine that a generalist POSITA would be able to design systems to manage it without undue experimentation). In forming his opinions, Dr. Miles did not consider complicating factors such as Kirkendall porosity, testifying in his deposition: “Is it – is Kirkendall porosity a big deal in this application? I don’t know. ... I didn’t consider [Kirkendall porosity] in my declaration.” Ex. 2021 at 234:22-23, 235:7-8. Instead, Dr. Miles appears to assume that the diffusion kinetics and resulting elemental composition of each layer (and the relationships of the elemental

composition among the layers) will remain the same if coating thickness is simply increased. But this is inaccurate as explained above. *See also supra* sections IV, VI, and VII.B.

234. Thus, again a POSITA would not have had a reasonable expectation of success in modifying the microstructure of either Takagi or Suehiro with the thicker coating Dr. Miles attributes to either Cornette or GMW14400.

**3) The Process and Materials Parameters That Would
Need to Be Varied to Achieve Petitioner's
Combination Are Not Result Effective Variables**

235. I understand that for a parameter to be a results-effective variable (1) the prior art must teach that the specific parameter achieves a recognized result and (2) if so, why the optimization of that parameter would lead to the claimed invention.

236. In contrast, Dr. Miles appear to believe any variable that effectuates a change is result-effective regardless of whether a relationship between that variable (and any other interdependent or interrelated variables) and its effect is known.

7 Q. So are we in agreement, then, that the
8 result -- that a result effective parameter is not a
9 parameter that when you change it, the result could be
10 unpredictable or inconsistent?

11 A. I think it depends on how much you change
12 it. But if you are changing it within a relatively
13 small range, I think it's more -- more than likely that
14 it's going to be predictable.

15 If you change it a lot, perhaps, it
16 wouldn't be as predictable. So that would still be a
17 result effective parameter. It's just that the way in
18 which you decide to modify the parameter and the
19 magnitude could give you a result that you're looking
20 for, perhaps not.

Ex. 2021 at 129:7-20.

237. As I explain above, there are many parameters involved with hot stamping. It is not possible, as Dr. Miles appears to suggest, to isolate one attribute and focus on changing that while keeping all other attributes the same. Instead, as soon as one parameter is changed to impact one attribute, the change in that one parameter will impact all other aspects of the hot stamping process. *See also supra* sections IV, VI, and VII.B.

238. The same is true for pre-coating composition (varying the Al% and Si% in the pre-coating) or varying the base steel composition—such changes can have a nonlinear impact on the heating process, the formation of layers, the growth of the layers, the diffusion kinetics, the Kirkendall effect (the formation of voids in

microstructural layers), the composition of the layers, and the characteristics of the final coating. Petitioner and Dr. Miles significantly oversimplify that complex multidimensional relationship among these parameters in hot stamping.

239. Here, Dr. Miles assumes that, simply because a variable is known to have some impact at some level of modulation on some aspect of the process, that is “result effective” and supposedly obvious to modify. This ignores, however, that the “known” impact that Dr. Miles points to may not be the factor that is relevant with respect to the Challenged Claims.

240. By way of example, Dr. Miles would treat target heating temperature as a result effective variable because it has a known result when modulated—the higher the temperature, the hotter the steel will be. But Dr. Miles misses that this variable does not have a direct, predictable, or understood relationship with the result *at issue here* with the Challenged Claims, namely, obtaining specific multi-phase layered microstructure featuring an intermetallic layer. What is not known is whether heating to, for example, 850°C, 900°C, or 950°C is better for obtaining the features required of the Challenged Claims. That determination is interdependent on numerous other variables, including heating rates, times, and compositions. As such, the variable cannot be said to be result effective with respect to the result sought to obtain the Challenged Claims.

241. As Dr. Miles conceded, none of the prior art references he cites as

identifying various variables as supposedly known “result effective” variables actually say as much. None of them assign that label. Ex. 2021 at 136:2-4. The “result effective” label is Dr. Miles gloss, based on his limited background and understanding of the subject matter of the Challenged Claims. But as noted above, while it is certainly known that every variable might effectuate a change of some kind, none of the variables at issue here were understood to alone have a known effect that would yield the result of the microstructure required of the Challenged Claims, and Dr. Miles cites no evidence to support otherwise.

4) It Would Not Have Been Obvious for a POSITA to “Try” to Substitute Cornette’s or GMW’s Thicker Coating into Takagi’s or Suehiro’s Microstructure

242. For the above reasons, I also disagree with Dr. Miles that it would have been “obvious to try” mixing and matching various parameters to achieve the Challenged Claims. POSITA would have understood the complexity and unpredictability at issue and would not have thought any of this would have been obvious to try. *See supra* sections IV and VI.

243. As noted above, the variables at issue here are not result-effective variables as I understand that term. Given that it is not predictable or straightforward to modulate such variables to form a specific intermetallic layered microstructure by diffusion kinetics during hot stamping as detailed above, a POSITA would know that there would be nothing routine about the

experimentation required to increase coating thickness in Takagi or Suehiro by 25% or more as Dr. Miles suggests (to thus supposedly obtain the Challenged Claims). This would not be an undertaking one would make given the undue and extensive experimentation that a POSITA would recognize to be required.

* * *

244. In sum, it would have taken an undue and excessive amount of experimentation to obtain the Challenged Claims. I disagree there would be anything routine about the experimentation required to obtain the Challenged Claims. As I explained above, even today, research is still being done about the complex relationship among the parameters, diffusion kinetics and microstructural layer formation which shows this is much more complex than routine experimentation. *See supra* sections VI.

245. If optimization of performance characteristics and microstructure were the straight-forward undertaking Dr. Miles assumes, achieved by mere “trial and error” and “routine experimentation” as he opines, then it seems absurd that exceptionally skilled researchers with many years of experience in this particular specialty (hot stamping aluminum-alloy coated steel) would have spent years to obtain design improvements, as was the actual real-world case with the Challenged Claims here.

246. In all, because of the complexity, unpredictability, specialized

knowledge and experience required—and still developing understanding in the field of the underlying kinetics—a POSITA, having but a generalist level of ordinary skill in the field, would not have been able to obtain the alleged combinations through mere routine experimentation nor had any reasonable expectation of doing so.

D. Cornette Would Not Prompt a Motivation to Combine.

247. I disagree with Dr. Miles that Cornette provides a motivation to combine. According to Dr. Miles, Cornette claims that a pre-coating layer thickness of 25 um provides the best compromise between corrosion and weldability. Cornette, however, does not say this. I have excerpted Dr. Miles's declaration below:

29. Further, beyond teaching a post hot-stamping coating thickness of 32 μm corresponding to Takagi's pre-coating thickness, Cornette illustrates that it would have been obvious to a POSITA to focus on the pre-coating thickness and the thickness of the coating after hot-stamping as parameters to be varied and optimized. In my review, I identified a number of prior art documents that attest to the importance of layer thickness for determining its properties and effectiveness. Cornette itself notes that "[t]he average [pre-coating] layer thickness showing the best compromise between corrosion protection and weldability is 25 μm " and links this "best" pre-coating thickness to a "typical" thickness of the alloyed "Fe-Al-Si" layer of "about 40 μm at the steel surface." EX-1014, 9. As a POSITA would have understood, Cornette's discussion of the "best compromise between corrosion protection and weldability" is clearly in reference to coatings, not pre-coatings, because the coating of a hot-stamped part, not the pre-coating, is what will be welded and what will protect against corrosion. As such, Cornette's discussion can equivalently be expressed as "[t]he average [pre-coating] layer thickness [that, when hot-stamped, produces a resulting coating with] the best compromise between corrosion protection and weldability is 25 μm , [and that resulting coating is] typically about 40 μm ." Guided by this description, a POSITA would certainly have been motivated to obtain relatively thick coatings (e.g., with a thickness of about 40 μm) in order to obtain the "best compromise between corrosion protection and weldability," based on which it would have been obvious to try the 25 μm that Cornette describes provides that thickness.

248. As shown, Dr. Miles concedes that Cornette's discussion of the "best compromise between corrosion protection and weldability" is "clearly" in

reference to coatings (i.e., *after* hot stamping) and not the pre-coating. I agree with Dr. Miles.

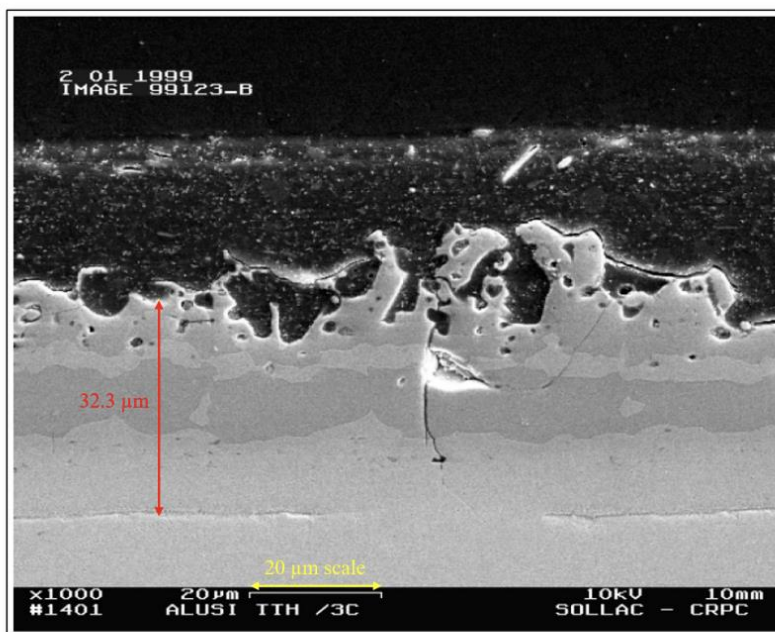
249. I disagree with what Dr. Miles does next. He then asserts that Cornette's statement that "The average layer thickness showing the best compromise between corrosion protection and weldability is 25 μm " must be referring to the pre-coating layer thickness. And he does this by inserting in brackets the word "pre-coating" before layer thickness. He then asserts that when Cornette says "The average layer thickness showing the best compromise between corrosion protection and weldability is 25 μm ," it really means "The average [pre-coating] layer thickness [that, when hot-stamped, produces a resulting coating with] the best compromise between corrosion protection and weldability is 25 μm , [and that resulting coating is] typically about 40 μm ." I disagree with this re-writing of Cornette.

250. First, it defies logic that there is a specific pre-coating thickness that achieves the best corrosion protection and weldability, which are attributes that are formed by the hot stamping process. In other words, corrosion protection and weldability are impacted by many things beyond just pre-coating thickness. For example, heating time, heating rate, thickness of the blank, oven type, atmospheric conditions, Kirkendall effect, porosity etc. Thus, it is impossible to isolate the pre-coating thickness and figure out what provides the "best" corrosion protection and

weldability. Indeed, Takagi's Table 1 shows that the same pre-coating thickness results in some structures that exhibit corrosion protection and weldability (e.g., Tests 1, 3, 4, and 5) and some that do not (e.g., Test 2).

251. Second, Dr. Miles's rewriting ignores how Cornette is written. Cornette did not states "The average layer thickness" and not "the average pre-coating layer thickness." If Cornette meant to describe pre-coating layer thickness, Cornette would have said so. Dr. Miles does not provide any reason why Cornette would have omitted pre-coating when describing layer thickness if Cornette intended to describe the pre-coating layer thickness.

252. And Dr. Miles is simply wrong that Cornette says a pre-coating layer thickness of 25 um typically results in a post-hot stamping layer thickness of 40 um. In fact, when Dr. Miles measured Cornette's Figure 22, he measured a layer thickness of 32.2 um, which is far from 40 um.



Cornette FIG. 22 (annotated)

Ex. 1003 ¶ 61.

253. As a result, a POSITA reviewing Cornette would not have been motivated to try a pre-coating of 25 um. If anything, POSITA would have been motivated to achieve a post-hot-stamp coating of 25 um.

254. In my opinion, a POSITA would not have had a reasonable expectation of success in achieving a post-coating thickness as deep as Dr. Miles suggests based on the references he cites. *See also supra* XI.B.

255. I further also disagree with Dr. Miles that a POSITA would have expected a thickness increase with heat treatment on the order of about “50%” from pre-coating to post-hot stamping. Ex. 1003 ¶ 31. Dr. Miles himself concedes that this “50%” number cited in his report is limited to the specific parameters outline in FR Laurent and is not providing a general relationship:

4	Q. Do you see that the statement that the
5	increase between the precoating and the post hot
6	stamping thickness is 50 percent is caveated in Laurent
7	as limited to the treatment specified above; correct?
8	A. Yes.
9	Q. Laurent does not purport to make a
10	universal statement that there is a 50 percent increase
11	that occurs in hot stamping between the precoating
12	thickness of aluminum alloy and the post hot stamping
13	thickness; correct?
14	A. Correct.

Ex. 2021 at 240:4-14.

256. Post-hot-stamped coating thickness is going to be impacted by multiple parameters during the heating process prior to hot stamping, including heating temperature, heating time, heating rate, oven size and more. *See supra* sections IV and VI. Dr. Miles relies on French Patent Publication No. FR2833504 (Ex. 1025, “Laurent”) for this alleged relationship. *See* Ex. 1003 ¶ 31. However, this publication is very clear that the 50% increase it describes pertains to the specific conditions used *in that reference alone*. Ex. 1025, 5:1-20 (“The alloying, through interdiffusion, leads to an increased thickness of the layer which, for the treatment *specified above*, generally corresponds to a 50% increase.” (emphasis added)).

257. As detailed here, the general notion that more leads to more (e.g., more pre-coating material leads to more post-stamping coating) says nothing about

how more pre-coating impacts diffusion kinetics and the formation of microstructural layering during the diffusion process. As Dr. Miles himself conceded, there is no constant that quantifies the ratio of diffusion-based increase that occurs in the thickness of the coating during heat treatment and hot stamping. And, even if particular heating parameters were designed to achieve a 50% growth (as would be required to “upscale” the coating in either Takagi or Suehiro to meet Petitioner’s proposed combination as Dr. Miles opines), it would not be possible to manage this “50%” increase from a thicker precoating as Petitioner and Dr. Miles propose without impacting the other properties of the final hot stamped coating. *See infra* sections IV and VI (complex multidimensional relationship).

E. GMW14400 Would Not Prompt a Motivation to Combine

258. As I mentioned above, GMW is a material specification from GM Worldwide Engineering Standards. Ex. 1026 (GMW14400) at 1. GMW would not drive a general market demand towards meeting its specification. That is because companies like GMW would obtain their parts from Tier 1 suppliers under contracts with those suppliers. Tier 1 suppliers are companies that hot stamp and produce parts for carmakers based on the designs. Thus, the general market would not have been the audience for GMW but rather individuals at Tier 1 suppliers who design the hot-stamping processes to manufacture those parts.

259. As a result, at best, GMW would have driven a demand for the

individuals at Tier 1 suppliers who design the hot-stamping processes to manufacture those parts to attempt to meet its specification. But those individuals are very different than a POSITA in this proceeding. A POSITA in this proceeding would have been an experienced technician working in some aspect of metallurgy. A POSITA would not have been someone who is risen to the highly specialized role of designing hot-stamping processing procedures for aluminum-alloy coated steel (much less specifically for GM). A POSITA would not have been motivated by GMW because GMW was directed to and intended for a very different and very specific audience. Thus, GMW would not have provided a motivation for a POSITA to combine either Takagi or Suehiro with GMW.

260. As noted above, obtaining a post-stamping coating thickness of greater than 35 μm means that more pre-coating must be used on the base steel at the beginning of the hot stamping process. This would have increased expenses because more pre-coating would mean more cost, and more risk of damage to heating lines due to fouling. GMW does not, however, describe any added benefit to using such a thick post-stamping coating. Absent being required by GM as a contracted supplier (which is not the position a POSITA would be in), a POSITA seeking to hot stamp aluminum-alloy coated steel would not have wanted to absorb increased costs and risk of equipment damage necessary to achieve a greater than 35 μm post-stamping coating thickness. As a result, without some specific benefit

attributable to a post-stamping coating thickness of greater than 35 μm , manufacturing costs and preservation of equipment would have counselled a POSITA against trying to obtain such a thick post-stamping coating thickness.

261. As noted above, a POSITA would not have been the audience for GMW and would not have been involved with the design of the hot-stamping process or the design of microstructural phase layers in aluminum alloy coatings. However, a POSITA would have been well-aware of the problems caused by using additional, thicker pre-coating or trying to obtain thicker post-hot stamped coatings. A technician or operator would have been well-aware of production problems created by fouling and the other issues I mentioned above.

262. Moreover, as detailed above, a POSITA would not have been able to reasonably take the disclosures of Takagi or Suehiro and redesign a heating, holding, stamping, and quenching parameters to obtain the same or analogous microstructural layering of Takagi or Suehiro, but just in a “super sized” thickness. It would have been incredibly challenging to create a process to address these problems, and substantially more expertise and experimentation would have been needed than what a typical POSITA in metallurgy could provide through routine experimentation.

263. In addition, even assuming a POSITA would have wanted to achieve 35 μm coatings despite the complexities of hot stamping additional pre-coating,

there is no reason a POSITA would have tried to do so while maintaining the claimed structure or composition of Takagi or Suehiro, which was not required of the GM specification. Instead, to the extent a POSITA wanted to meet GM's standards, a POSITA would have been only focused on meeting those requirements and not on creating additional difficulty to meet additional microstructural requirements from Takagi or Suehiro that were not required by GM. As a result, a POSITA would not have been focused on creating a four-layer microstructure structure featuring an intermetallic layer, as that was not needed for the GM specification. Doing so would have gratuitously required specific hot stamping parameters limiting the hot stamping manufacturer. Instead, a POSITA would have been focused on manufacturing parts as quickly and simply as possible for GM while adhering to the *minimum* requirements outlined in GMW14400.

264. All of these issues would have taught away from trying to achieve a post-stamping thickness of 35 μm or more stated in the GMW specification, in particular in combination with the microstructure of Takagi or Suehiro. These considerations would teach away from combining any coating described in either Takagi or Suehiro with GMW's thickness specification, especially because, as noted above, GMW does not require that the microstructural multi-layered architecture described in either Takagi or Suehiro be used at all.

265. In sum, rendering the combination would be (i) be beyond the skill of

a POSITA to reasonably achieve (and require exceptional and undue experimentation), (ii) more costly, (iii) risk equipment damage, (iv) of no identified additional identified benefit, (v) not required to meet the GMW14400 specification itself (or required by any other known supplier, manufacturer, or hot stamped part purchaser), and (vi) not material in any way to practicing what was disclosed in either Takagi or Suehiro. As such, a POSITA would have no motivation to combine either Takagi or Suehiro with GMW14400's thickness specification, much less with any reasonable expectation of success.

F. Claims 19 and 21 are not disclosed by the Asserted Combinations

266. Claims 19 and 21 require specific compositional percentages for various layers. None of Petitioner's prior art references individually disclose the recited claim elements.

267. For the Takagi-based combinations, Dr. Miles alleges that a POSITA would have been motivated to experiment. I disagree. A POSITA would not start experimenting with different compositional percentages because that would impact the entire hot stamped product. It would not be possible to directly change the composition of one layer without changing the composition of any other layer.

268. Dr. Miles does not explain how a POSITA would be able to change the composition of a layer, or why a POSITA would even be motivated to do so, while still preserving the compositional relationship in the independent claim.

269. I have not seen any evidence that a POSITA would have had a reasonable expectation of success in trying to achieve the claimed limitations, which is something that none of references actually disclose.

270. For the Suehiro-based combination, Dr. Miles refers to his Takagi reasoning.

271. As a result, in my opinion, the asserted combinations do not disclose claims 19 and 21.

G. SECONDARY CONSIDERATIONS

272. In my opinion, there was also a long unmet need in the industry for the claimed invention. Hot stamping existed since the late 1970s. But before the invention, automotive manufacturers were unable to achieve consistent, reliable steel that had all the benefits of the patented invention, including characteristics like improved corrosion resistance and weldability. *E.g.*, Ex. 1001, at 2:7-37. As a result, while automakers could use USIBOR (the “P” indicates pre-coated) for bolted parts, it was incredibly difficult to use USIBOR 1500P for welded parts because hot-stamped USIBOR 1500P had weldability issues, corrosion issues, and paintability issues. This long-felt need was satisfied by the claimed invention, which simultaneously allowed for improved weldability, paintability, corrosion resistance, and resistance to abrasion, wear, fatigue, and shock. Ex. 1001, at 2:64-67, 6:12-29, 8:15-20, 9:50-55, 11:32-39.

XII. CONCLUSION

273. The findings and opinions set forth in this declaration are based on my work and examinations to date.

274. I may continue my examinations. I may also receive additional documentation and other factual evidence over the course of this IPR that will allow me to supplement and/or refine my opinions. I reserve the right to add to, alter, or delete my opinions and my declaration upon discovery of any additional information. I reserve the right to make such changes as may be deemed necessary.

275. In signing this declaration, I recognize that the declaration will be filed as evidence in an IPR before the PTAB. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

276. I hereby declare that all statements made herein of my own knowledge are true and that all statements are made on information and belief are believed to be true; and further these statements were made with the knowledge that willful false statements and the like are punishable by fine, imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that those

statements may jeopardize the validity of the patent at issue.

DATE: November 19, 2025

A handwritten signature in black ink, appearing to be 'Karl', written above a horizontal line.