

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HANWHA SOLUTIONS CORPORATION,

Petitioner,

v.

MAXEON SOLAR PTE. LTD.,

Patent Owner.

Case No. IPR2024-01198

U.S. Patent No. 11,251,315

**DECLARATION OF GILBERT T. SMOLENSKI REGARDING
EXHIBITS 1093-1097, 1100, 1103-1104, 1107-1108, 1111-1116, 1118-1122,
1124-1132, 1135, 1137-1139**

HANWHA v. MAXEON
IPR2024-01198
HANWHA 1141

I, Gilbert T. Smolenski, declare as follows:

1. I am an attorney at the law firm of Wilmer Cutler Pickering Hale and Dorr LLP in the Washington, DC office, which represents the Petitioner Hanwha Solutions Corporation in this proceeding.

2. I was involved in the preparation of the Petitioner's Reply, and this declaration is based on my personal knowledge from being involved in the preparation of the Petitioner's Reply.

3. **Exhibit 1093** is a copy of an article titled "Effective impurity gettering by phosphorus- and boron-diffused polysilicon passivating contacts for silicon solar cells," and authored by AnYao Liu, Di Yan, Sieu Pheng Phang, Andres Cuevas, and Daniel Macdonald. This article was published in *Solar Energy Materials and Solar Cells* and has a copyright date of 2017. **Exhibit 1093** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

4. **Exhibit 1094** is a copy of an article titled "Transition-metal profiles in a multicrystalline silicon ingot," and authored by Daniel Macdonald, Andrés Cuevas, A. Kinomura, Y. Nakano, and L. J. Geerligs. This article was published in the *Journal of Applied Physics* and is dated January 2005. **Exhibit 1094** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

5. **Exhibit 1095** is a copy of an article titled “Gettering in silicon photovoltaics: current state and future perspectives,” and authored by M. Seibt, A. Sattler, C. Rudolf, O. Voß, V. Kveder, and W. Schröter. This article was published in *Physica Status Solidi (A) Applications and Materials Science* and is dated March 2006. **Exhibit 1095** is a true and accurate copy of this article that was obtained while preparing Petitioner’s Reply.

6. **Exhibit 1096** is a copy of an article titled “Metal content of multicrystalline silicon for solar cells and its impact on minority carrier diffusion length,” and authored by A. A. Istratov, T. Buonassisi, R. J. McDonald, A. R. Smith, R. Schindler, J. A. Rand, J. P. Kalejs, and E. R. Weber. This article was published in the *Journal of Applied Physics* and is dated November 2003. **Exhibit 1096** is a true and accurate copy of this article that was obtained while preparing Petitioner’s Reply.

7. **Exhibit 1097** is a copy of an article titled “The Impact of Interstitial Fe Contamination on N-Type Cz-Silicon for High Efficiency Solar Cells,” and authored by Ali Hajjiah, Marton Soha, Ivan Gordon, Jozef Poortmans, and Joachim John. This article was published in *Solar Energy Materials and Solar Cells* and has a copyright date of 2020. **Exhibit 1097** is a true and accurate copy of this article that was obtained while preparing Petitioner’s Reply.

8. **Exhibit 1100** is a copy of an article titled “Transition metals in photovoltaic-grade ingot-cast multicrystalline silicon: Assessing the role of impurities in silicon nitride crucible lining material,” and authored by T. Buonassisi, A.A. Istratov, M.D. Pickett, J.-P. Rakotoniaina, O. Breitenstein, M.A. Marcus, S.M. Heald, and E.R. Weber. This article was published in the *Journal of Crystal Growth* and has a copyright date of 2005. **Exhibit 1100** is a true and accurate copy of this article that was obtained while preparing Petitioner’s Reply.

9. **Exhibit 1103** is a copy of an article titled “Two-Dimensional Analysis Of The Interdigitated Back-Contact Solar Cell,” and authored by D.J. Chin and D.H. Navon. This article was published in *Solid-State Electronics* and has a copyright date of 1981. **Exhibit 1103** is a true and accurate copy of this article that was obtained while preparing Petitioner’s Reply.

10. **Exhibit 1104** is a copy of an article titled “A simple general analytical solution for the quantum efficiency of front-surface-field solar cells,” and authored by X.M. Dai and Y.H. Tang. This article was published in *Solar Energy Materials and Solar Cells* and is dated 1996. **Exhibit 1104** is a true and accurate copy of this article that was obtained while preparing Petitioner’s Reply.

11. **Exhibit 1107** is a copy of an excerpt from the textbook *Solid State Electronic Devices*, authored by Ben G. Streetman and Sanjay Kumar Banerjee. This excerpt was taken from the sixth edition published by Pearson Prentice Hall.

Exhibit 1107 is a true and accurate copy of this excerpt that was obtained while preparing Petitioner's Reply.

12. **Exhibit 1108** is a copy of an excerpt taken from *A Dictionary of Electronics and Electrical Engineering*. This excerpt was taken from the fifth edition published by Oxford University Press and has a copyright date of 2018. **Exhibit 1108** is a true and accurate copy of this excerpt that was obtained while preparing Petitioner's Reply.

13. **Exhibit 1111** is a copy of an article titled "Passivated Emitters in Silicon Solar Cells," and authored by Richard R. King, Peter E. Gruenbaum, Ronald A. Sinton, and Richard M. Swanson. This article was published in *IEEE Conference on Photovoltaic Specialists* and is dated 1990. **Exhibit 1111** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

14. **Exhibit 1112** is a copy of an article titled "Surface Passivation of High-Efficiency Silicon Solar Cells by Atomic-Layer-Deposited Al₂O₃," and authored by J. Schmidt, A. Merkle, R. Brendel, B. Hoex, M.C.M. van de Sanden, and W.M.M. Kessels. This article was published in *Progress in Photovoltaics: Research and Applications* and has a copyright date of 2008. **Exhibit 1112** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

15. **Exhibit 1113** is a copy of an article titled "Ultralow Surface Recombination of c-Si Substrates Passivated by Plasma-Assisted Atomic Layer

Deposited Al_2O_3 ,” and authored by B. Hoex, S. B. S. Heil, E. Langereis, M.C.M. van de Sanden, and W.M.M. Kessels. This article was published in *Applied Physics Letters* and is dated 2006. **Exhibit 1113** is a true and accurate copy of this article that was obtained while preparing Petitioner’s Reply.

16. **Exhibit 1114** is a copy of an article titled “Excellent Passivation of Highly Doped *p*-Type Si Surfaces by the Negative-Charge-Dielectric Al_2O_3 ,” and authored by B. Hoex, J. Schmidt, R. Bock, P.P. Altermatt, M.C.M. van de Sanden, and W.M.M. Kessels. This article was published in *Applied Physics Letters* and is dated 2007. **Exhibit 1114** is a true and accurate copy of this article that was obtained while preparing Petitioner’s Reply.

17. **Exhibit 1115** is a copy of a document titled “International Technology Roadmap for Photovoltaic (ITRPV): 2013 Results.” The document states it is “Supported by: SEMI” and is dated March 24, 2014. **Exhibit 1115** is a true and accurate copy of this document that was obtained from https://www.semi.org/sites/semi.org/files/docs/ITRPV_2014_Roadmap_Revision1_140324.pdf while preparing Petitioner’s Reply.

18. **Exhibit 1116** is a copy of a screenshot from Bernreuter Research Webpage, <https://www.bernreuter.com/polysilicon/price-trend/>, accessed in August 2025. **Exhibit 1116** is a true and accurate copy of this webpage that was obtained while preparing Petitioner’s Reply.

19. **Exhibit 1118** is a copy of an article titled “Surface Passivation of Crystalline Silicon Solar Cells: A Review,” and authored by Armin G. Aberle. This article was published in *Progress in Photovoltaics: Research and Applications* and is dated 2000. **Exhibit 1118** is a true and accurate copy of this article that was obtained while preparing Petitioner’s Reply.

20. **Exhibit 1119** is a copy of Chapter 3 from *Advanced Silicon Materials for Photovoltaic Applications*, titled “Role of Impurities in Solar Silicon,” authored by Gianluca Coletti, Daniel Macdonald, and Deren Yang. This chapter was taken from the first edition, published by John Wiley & Sons, Ltd., and is dated 2012. **Exhibit 1119** is a true and accurate copy of this chapter that was obtained while preparing Petitioner’s Reply.

21. **Exhibit 1120** is a copy of a Ph.D. thesis titled “Impurities in silicon and their impact on solar cell performance,” and authored by Gianluca Coletti. This thesis was published through Utrecht University and has a copyright date of 2011. **Exhibit 1120** is a true and accurate copy of this thesis that was obtained while preparing Petitioner’s Reply.

22. **Exhibit 1121** is a copy of an article titled “Application of Neutron Activation Analysis in the Field of Silicon Technology for the Modern Electronic Industry,” and authored by M.L. Verheijke, H.J.J. Jaspers, J.M.G. Hanssen, and M.J.J. Theunissen. This article was published in the *Journal of Radioanalytical and*

Nuclear Chemistry and is dated 1987. **Exhibit 1121** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

23. **Exhibit 1122** is a copy of an article titled "Impact of Metal Contamination of 7.0nm Gate Oxides on Various Substrate Materials," and authored by S. Saito, K. Hamada, D.J. Eaglesham, Y. Shiramizu, J.L. Benton, H. Kitajima, S.D.C. Jacobson, and J.M. Poate. This article was published in *Materials Research Society Symposium Proceedings* and has a copyright date of 1997. **Exhibit 1122** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

24. **Exhibit 1124** is a copy of Chapter IC-5 from *Solar Cells Materials, Manufacture and Operation*, titled "High-Efficiency Back-Contact Silicon Solar Cells for One-Sun and Concentrator Applications," and authored by Pierre. J. Verlinden. This chapter was taken from the second edition published by Elsevier and has a copyright date of 2013. ScienceDirect states that this article was available online on October 19, 2012. See <https://www.sciencedirect.com/science/article/abs/pii/B9780123869647000111?via%3Dihub>. **Exhibit 1124** is a true and accurate copy of this chapter that was obtained while preparing Petitioner's Reply.

25. **Exhibit 1125** is a copy of an article titled "A Gettering Simulator: Evaluating Contamination and Gettering Processes," and authored by C. del Cañizo, L.J. Caballero, R. Esteban, and A. Luque. This article was published in *3rd World*

Conference on Photovoltaic Energy Conversion and is dated 2003. **Exhibit 1125** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

26. **Exhibit 1126** is a copy of an article titled "Impurity-to-efficiency simulator: predictive simulation of silicon solar cell performance based on iron content and distribution," and authored by J. Hofstetter, D.P. Fenning, M.I. Bertoni, J.F. Lelièvre, C. del Cañizo, and T. Buonassisi. This article was published in *Progress in Photovoltaics: Research and Applications* and is dated 2010. **Exhibit 1126** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

27. **Exhibit 1127** is a copy of an article titled "Towards the tailoring of P diffusion gettering to as-grown silicon material properties," and authored by Jasmin Hofstetter, Jean-François Lelièvre, David P. Fenning, Mariana I. Bertoni, Tonio Buonassisi, and Carlos del Cañizo. This article was published in *Solid State Phenomena* and has a copyright date of 2011. **Exhibit 1127** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

28. **Exhibit 1128** is a copy of an article titled "Extended spectral response analysis of conventional and front surface field solar cells," and authored by Dongchen Lan, and Martin A. Green. This article was published in *Solar Energy*

Materials & Solar Cells and is dated 2015. **Exhibit 1128** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

29. **Exhibit 1129** is a copy of an article titled "PC1D Version 5: 32-Bit Solar Cell Modeling on Personal Computers," and authored by Donald A. Clugston, and Paul A. Basore. This article was published in *Conference Record of the Twenty Sixth IEEE Photovoltaic Specialists Conference* and has a copyright date of 1997. **Exhibit 1129** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

30. **Exhibit 1130** is a copy of an article titled "End of polysilicon shortages in 2008." This article was posted at the following webpage, https://siliconsemiconductor.net/article/70361/End_of_polysilicon_shortages_in_2008 and is dated February 19, 2008. **Exhibit 1130** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

31. **Exhibit 1131** is a copy of an article titled "Acceptable contamination levels in solar grade silicon: From feedstock to solar cell," and authored by J. Hofstetter, J.F. Lelièvre, C. del Cañizo, and A. Luque. This article was published in *Materials Science and Engineering B* and is dated 2009. **Exhibit 1131** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

32. **Exhibit 1132** is a copy of a screenshot from a web-archived page "Aerospace Corporation, About Us," that was accessed on August 6, 2025 at

8:21AM from <https://web.archive.org/web/20141112022222/http://www.aerospace.org/about-us/>. **Exhibit 1132** is a true and accurate copy of this screenshot that was obtained while preparing Petitioner's Reply.

33. **Exhibit 1135** is a copy of a screenshot from a webpage "PV Lighthouse" accessed on August 8, 2025 at 9:33AM from <https://www.pvlighthouse.com.au/cms/simulation-programs/pc1d>. **Exhibit 1135** is a true and accurate copy of this screenshot that was obtained while preparing Petitioner's Reply.

34. **Exhibit 1137** is a copy of an article titled "Iron gettering in CZ silicon during the industrial solar cell process," and authored by A. Laades, K. Lauer, C. Maier, D. Alber, M. Bähr, J. Nutsch, J. Lossen, and A. Lawerenz. This article was published in *Solid State Phenomena* and is dated 2009. **Exhibit 1137** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

35. **Exhibit 1138** is a copy of an article titled "Gettering in silicon photovoltaics: A review," and authored by AnYao Liu, Sieu Pheng Phang, and Daniel Macdonald. This article was published in *Solar Energy Materials and Solar Cells* and is dated 2022. **Exhibit 1138** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

36. **Exhibit 1139** is a copy of an article titled "Metallic Impurities in Mono and Multi-crystalline Silicon and Their Gettering by Phosphorus Diffusion," and

authored by Mohammad B. Shabani, T. Yamashita, and E. Morita. This article was published in *ECS Transactions* and is dated 2008. **Exhibit 1139** is a true and accurate copy of this article that was obtained while preparing Petitioner's Reply.

37. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. 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.

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

Dated: September 5, 2025

/s/Gilbert T. Smolenski

Gilbert T. Smolenski
Registration No: 78,549
WILMER CUTLER PICKERING
HALE AND DORR LLP
2100 Pennsylvania Avenue NW
Washington, DC 20037
Tel: 202-663-6295
Email: gilbert.smolenski@wilmerhale.com