

**IN THE UNITED STATES DISTRICT COURT  
FOR THE EASTERN DISTRICT OF TEXAS  
MARSHALL DIVISION**

PRESIDENT AND FELLOWS OF  
HARVARD COLLEGE

Plaintiff,

v.

SAMSUNG ELECTRONICS, CO. LTD.,  
SAMSUNG ELECTRONICS AMERICA,  
INC., SAMSUNG SEMICONDUCTOR,  
INC., and SAMSUNG AUSTIN  
SEMICONDUCTOR, LLC,

Defendants.

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Civil Action No. 2:24cv636

**JURY TRIAL DEMANDED**

**COMPLAINT**

Plaintiff, President and Fellows of Harvard College (“Harvard”), by and through its undersigned counsel, for its Complaint against Defendant Samsung Electronics, Co., Ltd. (“SEC”), Defendant Samsung Electronics America, Inc. (“SEA”), Defendant Samsung Semiconductor, Inc. (“SSI”), and Samsung Austin Semiconductor, LLC (“SAS”) (collectively, “Samsung” or “Defendants”), alleges as follows:

**INTRODUCTION**

1. This is an action for patent infringement under the patent laws of the United States, 35 U.S.C. §§ 271 *et seq.*, to obtain damages resulting from Defendants’ unauthorized and ongoing actions of making, having made, using, selling, having sold, offering to sell, importing, and/or having imported into the United States products that infringe or enable the infringement of one or more claims of United States Patent Nos. 7,973,189 (the “189 Patent”), and 7,560,581 (the “581 Patent”) (collectively, the “Asserted Patents”), including, without limitation,

microprocessors and memory devices (“chips”), and the mobile phones, laptops, tablet computers, and other products that contain those chips (the “Accused Products”).

### **THE PARTIES**

2. Plaintiff Harvard is an educational institution and charitable corporation organized under the laws of the Commonwealth of Massachusetts with its principal place of business at Massachusetts Hall, Cambridge, MA 02138.

3. Upon information and belief, Defendant Samsung Electronics, Co., Ltd. (SEC) is a corporation organized and existing under the laws of the Republic of Korea, with its principal place of business at 129 Samsung-ro, Yeongtong-gu, Suwon, Gyeonggi, 16677, Republic of Korea. On information and belief, SEC is the ultimate parent corporation for SEA, SSI, and SAS. SEC may be served with process under Fed. R. Civ. P. 4(f) and 4(h).

4. Upon information and belief, SEC is responsible for and/or controls the infringing activities identified in this Complaint, including at least manufacturing infringing products, having infringing products made, selling and/or importing infringing products, and having infringing products sold and/or imported.

5. Upon information and belief, Defendant Samsung Electronics America, Inc. (SEA) is a corporation organized and existing under the laws of the State of New York, with a principal place of business at 85 Challenger Road, Ridgefield Park, New Jersey 07660. SEA is a wholly owned subsidiary of SEC. SEA maintains facilities in this District at least at 6625 Excellence Way, Plano, Texas 75023. SEA may be served with process through its registered agent CT Corporation Systems, 1999 Bryan Street, Suite 900, Dallas, Texas 75201-3136.

6. Upon information and belief, SEA oversees sales and distribution of Samsung’s consumer electronics products, including the products accused of infringement in this case.

7. Upon information and belief, Defendant Samsung Semiconductor, Inc. (SSI) is a corporation organized and existing under the laws of the State of California, with its principal place of business at 3655 North First Street, San Jose, California 95134. SSI is a wholly owned subsidiary of SEA. SSI may be served with process through its registered agent for service in Texas: National Registered Agents, Inc, 1999 Bryan St., Suite 900, Dallas, TX 75201.

8. Upon information and belief, SSI oversees sales and distribution of Samsung's chip products, including the products accused of infringement in this case.

9. Upon information and belief, Defendant Samsung Austin Semiconductor, LLC (SAS) is a corporation organized and existing under the laws of the State of Delaware, with its principal place of business at 12100 Samsung Blvd., Austin, Texas 78754. SAS is a wholly owned subsidiary of SSI. SAS may be served with process through its registered agent for service in Texas: National Registered Agents, Inc, 1999 Bryan St., Suite 900, Dallas, TX 75201.

10. Upon information and belief, SAS manufactures and sells products in Texas, including the products accused of infringement in this case.

11. Defendants SEA, SSI, and SAS act with respect to the infringing activities described herein at the direction and/or under the control of SEC.

12. Samsung offers its products and services, including the products accused of infringement in this Complaint, to customers and potential customers located in this District.

### **JURISDICTION AND VENUE**

13. This is an action for patent infringement under the patent laws of the United States, 35 U.S.C. §§ 271 *et seq.* This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. §§ 1331, 1338(a), 1367, and 2201.

14. This Court also has jurisdiction pursuant to 28 U.S.C. § 1332, as complete diversity among the parties exists and the amount in controversy exceeds \$75,000.

15. Venue is proper in this district pursuant to 28 U.S.C. § 1391(b) and (d) and 28 U.S.C. § 1400. SEC is subject to venue in any judicial district. *See* 28 U.S.C. § 1391(c)(3); *In re HTC Corp.*, 889 F.3d 1349 (Fed. Cir. 2018). Samsung, at least through one or more of SEA, SSI, and SAS, is registered to do business in Texas, and upon information and belief, has transacted business in this District, has committed acts of infringement in this District, and has regular and established places of business in this District, as set forth above. Further, Samsung offers and markets the products alleged herein as infringing to customers in Texas, including in this District, as set forth above. Additionally, each of SEC, SEA, SSI, and SAS has not challenged venue in this District in previous patent infringement actions.

16. Samsung is subject to this Court's jurisdiction pursuant to due process and the Texas Long Arm Statute due at least to its substantial business in this State and District, including (a) its infringing activities, (b) regularly doing or soliciting business, and/or (c) engaging in persistent conduct and/or deriving substantial revenue from goods and services provided to customers, as set forth above. The exercise of jurisdiction over Samsung is thus fair and reasonable.

### **BACKGROUND**

17. Established in 1636, Harvard is the nation's oldest institution of higher learning and is recognized as one of the world's leading academic institutions. The range of research activities at Harvard is broad and deep. Harvard scholars conduct research in almost every field of knowledge and constantly seek to expand human knowledge through analysis, innovation, and insight. Researchers include faculty members, visiting scholars, post-doctoral fellows, and graduate and undergraduate students. These researchers collaborate with colleagues across Harvard, at Harvard-affiliated institutions, at other research institutions, and with private corporations throughout the world.

18. Harvard has a long history of benefiting the public through its research programs. Harvard recognizes that the public benefits from new products and processes resulting from discoveries and inventions made by individuals connected with Harvard in the course of their scholarly and research activities. Harvard protects and manages the intellectual property that results from the efforts of its researchers to the benefit of, among others, the researchers, Harvard, and the public.

19. Professor Roy G. Gordon worked for and performed research in Harvard's Department of Chemistry for over 50 years. Professor Gordon served as Chairman of the Department of Chemistry and was the Thomas D. Cabot Professor of Chemistry. The Department of Chemistry at Harvard, through its faculty, students, postdoctoral fellows, and other research scholars, works in first-class facilities on individual investigator-led research projects and in collaboration with others in a broad spectrum of chemistry topics.

20. Professor Gordon's research spanned a wide range of subjects including applied mathematics, quantum mechanics, spectroscopy, intermolecular forces, solid state, and materials science. His theoretical work led to a better understanding of bonding in molecules and solids, and to predictions of new solid phases and phase transitions. His discoveries of new materials and vapor deposition processes are widely used commercially for making thin films in solar cells, energy-conserving window coatings, display devices, and semiconductor electronics.

21. Professor Gordon, along with Jill Becker, Seigi Suh, Hoon Kim, and Harish Bhandari, are named inventors on the '189 Patent and/or the '581 Patent. Harvard is the assignee of each of the Asserted Patents and owns all right, title, and interest in the Asserted Patents.

22. The inventions claimed by the Asserted Patents include, for example, novel processes and materials for deposition of thin films that contain cobalt or tungsten metals. Such films are essential to key components of numerous products such as computers and cell phones.

23. Samsung advertises that it is a leader in advanced semiconductor systems with a broad portfolio of high-performance technologies, including microprocessors and memory.<sup>1</sup> Samsung is the largest manufacturer of semiconductors in the world by revenue.<sup>2</sup>

24. Samsung owns and operates semiconductor manufacturing facilities both in the United States and abroad. Samsung manufactures certain products, including at least microprocessors, in Samsung's semiconductor manufacturing facilities in the United States.<sup>3</sup> Samsung manufactures certain products, including at least microprocessors and memory, in Samsung's semiconductor manufacturing facilities abroad. Samsung manufactures these products both for itself and for third parties.<sup>4</sup>

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<sup>1</sup> See Samsung Semiconductor, Processor, available at <https://semiconductor.samsung.com/processor/> (last viewed Jul. 15, 2024); Samsung Semiconductor, DRAM, available at <https://semiconductor.samsung.com/dram/> (last viewed Jul. 15, 2024).

<sup>2</sup> Press Release, Gartner, *Gartner Says Worldwide Semiconductor Revenue Grew 1.1% in 2022* (Jan. 17, 2023), available at <https://www.gartner.com/en/newsroom/press-releases/2023-01-17-gartner-says-worldwide-semiconductor-revenue-grew-one-percent-in-2022#:~:text=Worldwide%20semiconductor%20revenue%20increased%201.1,for%2077.5%25%20of%20the%20market.>

<sup>3</sup> See Samsung Semiconductor, History, available at <https://semiconductor.samsung.com/us/sas/company/history/> (last viewed Jul. 15, 2024); see also *Austin, Texas Named New Home for Samsung Electronics*, Samsung Semiconductor, Jan. 16, 1996, available at <https://semiconductor.samsung.com/news-events/news/austin-texas-named-new-home-for-samsung-electronics/>.

<sup>4</sup> *Samsung Electronics and Qualcomm Expand Foundry Cooperation on EUV Process Technology*, Samsung Semiconductor, Feb. 22, 2018, available at <https://semiconductor.samsung.com/news-events/news/samsung-electronics-and-qualcomm-expand-foundry-cooperation-on-euv-process-technology.>

25. Upon information and belief, the processes Samsung uses in Samsung's semiconductor manufacturing facilities, both in the United States and abroad, to manufacture certain products, including microprocessors and/or memory, infringe the Asserted Patents, namely by using deposition processes and materials claimed by the Asserted Patents.

26. Upon information and belief, Samsung's products that are manufactured using the deposition processes and materials claimed by the Asserted Patents are incorporated into computing, consumer, enterprise, networking, mobile, and automotive products, and are offered for sale, sold, and used throughout the United States, including within this District.

**COUNT I**  
**(INFRINGEMENT OF U.S. PATENT NO. 7,973,189)**

27. Harvard hereby re-alleges and incorporates by reference the foregoing paragraphs of the Complaint as if fully set forth herein.

28. On July 5, 2011, the United States Patent and Trademark Office ("USPTO") duly and legally issued U.S. Patent No. 7,973,189, entitled "Cobalt nitride layers for copper interconnects and methods for forming them," to inventors Roy G. Gordon, Hoon Kim, and Harish Bhandari (the "'189 Patent"). A true and correct copy of the '189 Patent is attached as Exhibit A to this Complaint.

29. Harvard is the assignee and owner of the '189 Patent with the exclusive right to enforce the '189 Patent against Samsung and the exclusive right to collect damages from Samsung for infringement of the '189 Patent for all relevant times, which rights include the right to prosecute this action. To the extent applicable, Harvard has at all times complied with 35 U.S.C. § 287 with respect to the '189 Patent.

30. On information and belief, Samsung infringes, and has infringed, one or more claims of the '189 Patent under 35 U.S.C. § 271(a), either literally or under the doctrine of

equivalents, without authority, consent, right, or license, by making products in the United States using a Samsung process that includes all of the limitations of at least one of the claims of the '189 Patent.

31. On information and belief, Samsung infringes, and has infringed, one or more claims of the '189 Patent under 35 U.S.C. § 271(g), either literally or under the doctrine of equivalents, without authority, consent, right, or license by importing into the United States and/or offering to sell, selling, and/or using within the United States, products made by Samsung using a Samsung process that includes all of the limitations of at least one of the claims of the '189 Patent.

32. As set forth above and in further detail in paragraphs 40 to 51 below, Samsung manufactures certain products, including microprocessors, at Samsung's semiconductor manufacturing facilities in the United States and abroad using a Samsung process that infringes the '189 Patent.<sup>5</sup> For example, on information and belief, Samsung fabricates at least the Qualcomm Snapdragon 8 Generation 1 product (hereafter "Snapdragon 8") using a Samsung process that practices each element of at least one claim of the '189 Patent. On information and belief, the Snapdragon 8 is representative of Samsung's manufacture of semiconductor products, including microprocessors, that are made abroad and in the United States.

33. Samsung operates a public website, Samsung.com, which is accessible in this District. Through Samsung.com, Samsung sells and advertises for sale products that include

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<sup>5</sup> See Samsung Semiconductor, History, available at <https://semiconductor.samsung.com/us/sas/company/history/> (last viewed Jul. 15, 2024); see also *Austin, Texas Named New Home for Samsung Electronics*, Samsung Semiconductor, Jan. 16, 1996, available at <https://semiconductor.samsung.com/news-events/news/austin-texas-named-new-home-for-samsung-electronics/>.



microprocessors made using a process that includes all of the limitations of at least one of the claims of the '189 Patent.

34. On information and belief, Samsung also actively induces and/or contributes to, and has induced and/or contributed to, infringement of the '189 Patent under 35 U.S.C. §§ 271(b) and (c), either literally or under the doctrine of equivalents, and continues to do so.

35. Samsung has knowledge of the '189 Patent and notice of Harvard's allegations of infringement thereof at least as of the filing of this Complaint. Samsung has further had knowledge of the '189 Patent since at least September 16, 2014 – the date of issuance of its U.S. Patent No. 8,834,968, which cites to the '189 Patent.

36. On information and belief, SEC has induced and continues to knowingly, actively, and intentionally induce SEA, SSI, SAS, and/or others to infringe the '189 Patent, including by inducing SEA, SSI, SAS, and/or others to manufacture, sell, offer to sell, and/or use in the United States, or import into the United States, products made using, or that include products made using, a Samsung process that infringes the '189 Patent.

37. On information and belief, Samsung has induced and continues to knowingly, actively, and intentionally induce others to infringe the '189 Patent and/or contribute to the infringement of others, by acts including, but not limited to, selling and/or importing products made using, or that include products made using, a process that includes all of the limitations of at least one of the claims of the '189 Patent, inducing others to sell or offer for sale such products, marketing the capabilities of such products, and providing, or making available, instructions, technical support, and/or other encouragement for the use of such products. For example, Samsung's Galaxy S22 smartphone includes a Snapdragon microprocessor and is advertised, sold, and supported by Samsung in partnership with third parties, including wireless

network carriers.<sup>6</sup> On information and belief, at least one distribution partner and/or customer has infringed one or more claims of the '189 Patent by selling, offering to sell, and/or using in the United States, or importing into the United States, products made using, or that include products made using, a Samsung process that infringes the '189 Patent.

38. On information and belief, Samsung has contributed to others practicing the '189 Patent. The Accused Products are not staple commodities of commerce and are not suitable for substantial non-infringing use. By providing the Accused Products, Samsung has contributed to the infringement of the '189 Patent by end users, such as customers, who use the Accused Products.

39. As a result of Samsung's infringing conduct, Harvard has suffered damages and will continue to suffer damages in an amount that, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by the Court under 35 U.S.C. § 284.

40. The analysis below demonstrates how an exemplary Samsung microprocessor product is made using a process claimed by at least one claim of the '189 Patent. The claim and products analyzed below are exemplary and are not intended to limit Harvard's allegations. The analysis is based on information available to Harvard before discovery in this action. Harvard reserves the right to assert any additional claims of the '189 Patent against any infringing acts by Samsung.

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<sup>6</sup> Qualcomm, Samsung Galaxy S22 Product Page, <https://www.qualcomm.com/snapdragon/device-finder/smartphones/samsung-galaxy-s22> (last viewed Jul. 15, 2024); Samsung, Galaxy S22 Product Page <https://www.samsung.com/us/business/mobile/phones/galaxy-s/galaxy-s22-128gb-unlocked-sm-s901uzkaxaa/> (last viewed Jul. 15, 2024).

41. On information and belief, at least Samsung's fabrication of the Qualcomm Snapdragon 8 is made using a process that practices each element of at least claim 12 of the '189 Patent.

42. **Claim 12** recites:

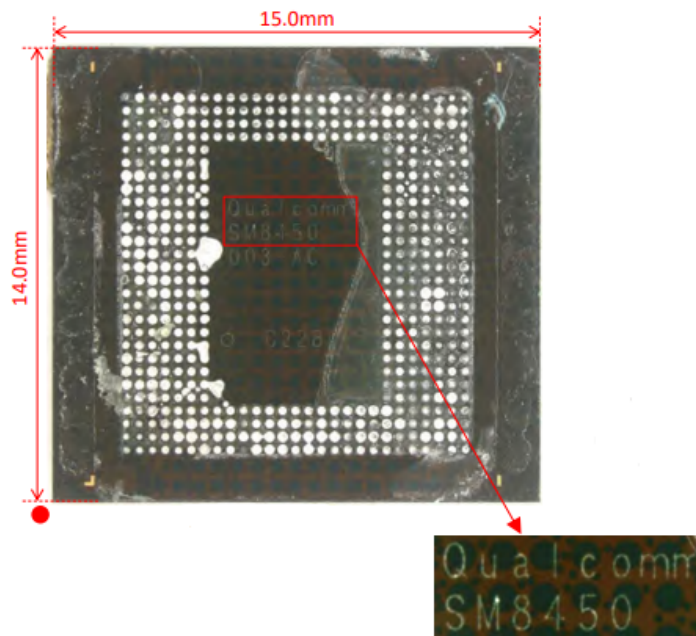
The method of forming a metal-comprising layer by chemical vapor deposition comprising:

exposing a substrate to a gaseous mixture comprising vapors of one or more metal amidinate selected from the metals lithium, sodium, potassium, beryllium, calcium, strontium, barium, scandium, yttrium, lanthanum and the other lanthanide metals, titanium, zirconium, hafnium, vanadium, niobium, tantalum, molybdenum, tungsten, manganese, rhenium, iron, ruthenium, cobalt, rhodium, nickel, palladium, silver, zinc, cadmium, tin, lead, antimony and bismuth.

43. On information and belief, Samsung performs a process for making a metal-comprising layer by chemical vapor deposition ("CVD").<sup>7</sup> Samsung performs a process for making the metal-comprising layer as part of its manufacturing of Snapdragon 8 chips, such as the sample pictured below.

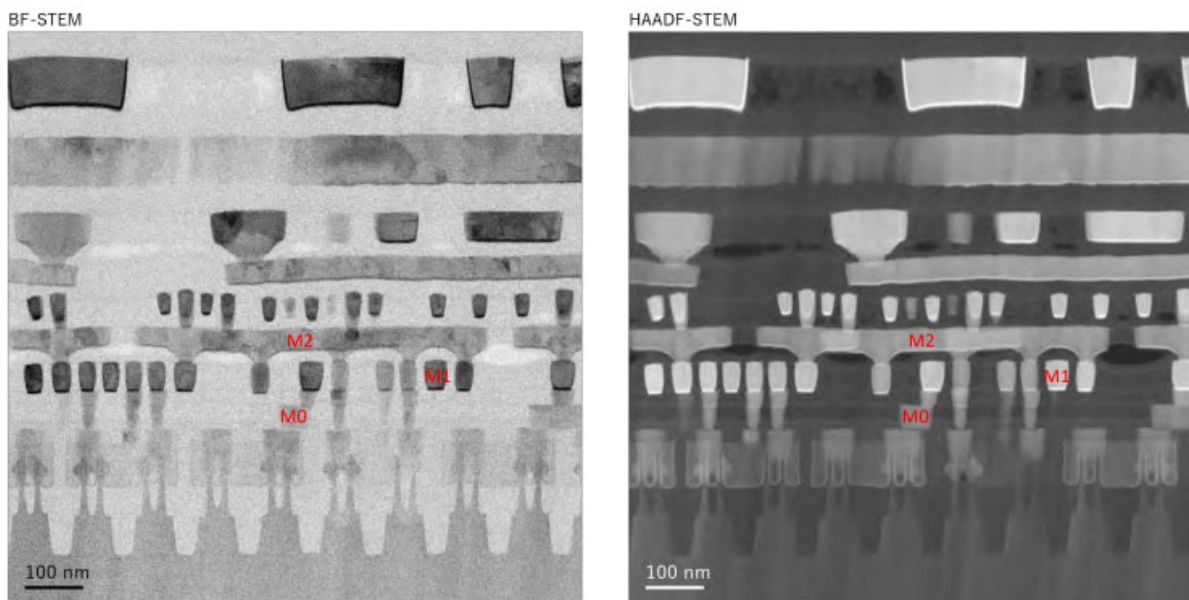
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<sup>7</sup> See *Samsung Fabrication Process Part 6: Giving Semiconductors Electrical Properties: The Deposition and Ion Implantation Processes*, Feb. 22, 2018, available at <https://semiconductor.samsung.com/us/support/tools-resources/fabrication-process/eight-essential-semiconductor-fabrication-processes-part-6-deposition-and-ion-implantation-for-the-electrical-properties/>



44. Snapdragon 8 chips include metal-comprising layers formed by material deposition. For example, the metal interconnects in the Snapdragon 8 chips include metal-comprising layers formed by chemical vapor deposition.

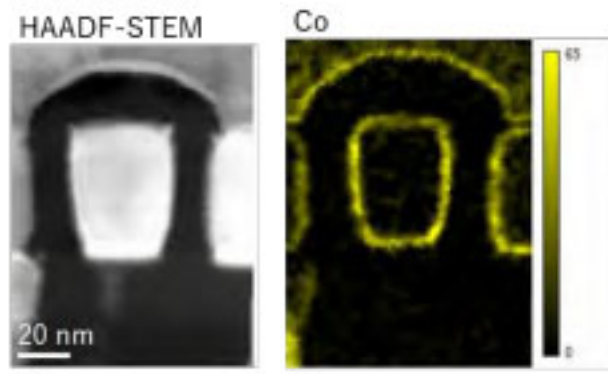
45. The teardown image below shows a plurality of interconnects in a Snapdragon 8 chip labeled M2, M1, and M0.



Upon information and belief, a metal-comprising layer is deposited upon the interconnects by CVD.<sup>8</sup> CVD is typically used to manufacture microprocessor metal interconnect films, such as those contained in the Snapdragon 8. The benefits of CVD use in the manufacture of microelectronic devices, such as film thickness and uniformity, are described in Samsung's own publications.<sup>9</sup>

46. On information and belief, the method of forming a metal-comprising layer by chemical vapor deposition used by Samsung comprises exposing a substrate to a gaseous mixture comprising vapors of a cobalt amidinate.

47. An analysis of a Samsung-fabricated Snapdragon 8 chip obtained by Harvard shows a metal interconnect that includes a cobalt layer. A teardown image showing Electron Energy Loss Spectroscopy (EELS) Elemental Mapping of the M1 interconnect, where the presence of a designated color indicates presence of the corresponding element, is shown below.



The teardown image above shows the cobalt layer (Co), appearing as a yellow outline of the M1 interconnect in the image.

<sup>8</sup> See *Samsung Fabrication Process Part 6: Giving Semiconductors Electrical Properties: The Deposition and Ion Implantation Processes*, Feb. 22, 2018, available at <https://semiconductor.samsung.com/us/support/tools-resources/fabrication-process/eight-essential-semiconductor-fabrication-processes-part-6-deposition-and-ion-implantation-for-the-electrical-properties/>

<sup>9</sup> *Id.*

48. To produce the Co (*i.e.*, metal-comprising cobalt) layer in the Snapdragon 8 using CVD, Samsung is required to use a precursor with appropriate reactive properties.

49. Samsung maintains the details of its CVD process for the fabrication of microprocessor chips as confidential business information. However, upon information and belief, Samsung uses cobalt amidinate during the CVD process used to manufacture the Snapdragon 8.<sup>10</sup> Cobalt amidinate is a metal amidinate as claimed in Claim 12 and is taught by the '189 Patent as having the appropriate reactive properties for the successful mass production of metal-comprising layers in semiconductor devices, such as microprocessors, using CVD.

50. Cobalt amidinate is a precursor that, when used in a CVD process, will produce a cobalt layer such as the one identified in the analysis conducted on a sample Snapdragon 8 chip fabricated by Samsung. In its own publications, Samsung has described deposition of cobalt metal layers on substrates by CVD.<sup>11</sup>

51. Thus, upon information and belief, the gaseous mixture comprising vapors of cobalt amidinate is exposed to the substrates of the Snapdragon 8 by CVD to form a cobalt-metal comprising layer.

**COUNT II**  
**(INFRINGEMENT OF U.S. PATENT NO. 7,560,581)**

52. Harvard hereby re-alleges and incorporates by reference the foregoing paragraphs of the Complaint as if fully set forth herein.

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<sup>10</sup> See *Samsung Fabrication Process Part 6: Giving Semiconductors Electrical Properties: The Deposition and Ion Implantation Processes*, Feb. 22, 2018, available at <https://semiconductor.samsung.com/us/support/tools-resources/fabrication-process/eight-essential-semiconductor-fabrication-processes-part-6-deposition-and-ion-implantation-for-the-electrical-properties/>

<sup>11</sup> Jungil Park, et al., *Advanced 5nm BEOL Integration Development for Manufacturing*, 2021 IEEE International Interconnect Technology Conference, Jul. 6-9, 2021.

53. On July 14, 2009, the USPTO duly and legally issued U.S. Patent No. 7,560,581, entitled “Vapor Deposition of Tungsten Nitride,” to inventors Roy G. Gordon, Seigi Suh, and Jill Becker (“’581 Patent”). A true and correct copy of the ’581 Patent is attached as Exhibit B to this Complaint.

54. Harvard is the assignee and owner of the ’581 Patent with the exclusive right to enforce the ’581 Patent against Samsung and the exclusive right to collect damages from Samsung for infringement of the ’581 Patent for all relevant times, which rights include the right to prosecute this action. To the extent applicable, Harvard has at all times complied with 35 U.S.C. § 287 with respect to the ’581 Patent.

55. On information and belief, Samsung infringes, and has infringed, one or more claims of the ’581 Patent under 35 U.S.C. § 271(g),<sup>12</sup> either literally or under the doctrine of equivalents, without authority, consent, right, or license, by importing into the United States and/or offering to sell, selling, and/or using within the United States, products made by Samsung using a Samsung process that includes all of the limitations of at least one of the claims of the ’581 Patent.

56. Samsung manufactures certain products, including memory, at Samsung’s semiconductor manufacturing facilities. As discussed below in paragraphs 64 to 77, on information and belief, Samsung fabricates at least the Samsung LPDDR5X DRAM memory products using a Samsung process that practices each element of at least one claim of the ’581

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<sup>12</sup> Based on publicly available information, Harvard understands that Samsung does not manufacture memory products in the United States. To the extent discovery shows that Samsung does manufacture memory in the United States that include tungsten layers, Samsung would also be liable for infringement under 35 U.S.C. § 271(a) in substantially the same manner as described above regarding the ’189 Patent. Harvard reserves all rights to allege infringement under § 271(a) accordingly.

Patent to deposit a tungsten layer. On information and belief, Samsung's fabrication process for its LPDDR5X DRAM memory products is representative of its fabrication process for Samsung's DDR5 DRAM memory products. Samsung's DDR3 DRAM memory also includes a tungsten layer,<sup>13</sup> and upon information and belief, Samsung's DDR4 DRAM memory includes a tungsten layer. On information and belief, Samsung's fabrication process for its DDR5 and DDR3 memory products is representative of its fabrication process for other Samsung memory products, including at least DDR4 DRAM, that include tungsten layers. On information and belief, Samsung's fabrication process for its DDR5 and DDR3 memory products is further representative of its fabrication process for other Samsung memory products, including at least NAND memory, that include tungsten layers.<sup>14</sup>

57. Samsung operates a public website, Samsung.com, which is accessible in this District. Through Samsung.com, Samsung sells and advertises for sale products that include

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<sup>13</sup> See Dick James, *Inside Today's Systems & Chips: A Survey of the Past Year*, Chipworks (2013), available at <https://www.slideshare.net/slideshow/dick-james-confab14/243151305#7>.

<sup>14</sup> See, e.g., Arabinda Das, *Samsung Hits Triple-Level-Cell NAND Flash Milestones*, EETimes, May 1, 2013, available at <https://www.eetimes.com/samsung-hits-triple-level-cell-nand-flash-milestone/>; Ron Maltiel, *Samsung's 3D NAND Teardown, Patent*, Semiconductor Expert, Dec. 15, 2014, available at <https://semiconductorexpert.blogspot.com/2014/12/samsungs-3d-nand-teardown-patent.html> (citing Andrew Walker, *Samsung's 3D V-Nand Flash Product: Ceaselessly Marching*, 3DInCites, Dec. 9, 2014, available at <https://www.3dincites.com/2014/12/samsungs-3d-v-nand-flash-product-ceaselessly-marching/>); U.S. Patent Application No. 2010/015,581; Dick James, *The Second Shoe Drops – Now We Have the Samsung V-NAND Flash*, Semiconductor Digest, Aug. 4, 2014, available at <https://www.semiconductor-digest.com/the-second-shoe-drops-now-we-have-the-samsung-v-nand-flash/>; Kevin Gibb, *First Look at Samsung's 48L 3D V-NAND Flash*, EETimes, Apr. 6, 2016, available at <https://www.eetimes.com/first-look-at-samsungs-48l-3d-v-nand-flash/2/>; R. Shirota, *Advances in Non-Volatile Memory and Storage Technology*, Chapter 8: 3D-NAND Flash Memory and Technology (2019), 285-301 available at [https://borecraft.com/PDF/Books%2C%20Chapters%2C%20Theses/3D\\_NAND\\_Flash\\_Memory\\_Technology.pdf](https://borecraft.com/PDF/Books%2C%20Chapters%2C%20Theses/3D_NAND_Flash_Memory_Technology.pdf).



memory made using a process that includes all of the limitations of at least one of the claims of the '581 Patent.

58. Samsung has knowledge of the '581 Patent and notice of Harvard's allegations of infringement thereof at least as of the filing of this Complaint.

59. On information and belief, SEC has induced and continues to knowingly, actively, and intentionally induce SEA, SSI, and/or others to infringe the '581 Patent, including by inducing SEA, SSI, and/or others to sell, offer to sell and/or use in the United States, or import into the United States, products made using, or that include products made using, a Samsung process that infringes the '581 Patent.

60. On information and belief, Samsung also actively induces and/or contributes to, and has induced and/or contributed to, infringement of the '581 Patent under 35 U.S.C. §§ 271(b) and (c), either literally or under the doctrine of equivalents, and continues to do so.

61. On information and belief, Samsung has and continues to knowingly and actively induce others to infringe the '581 Patent and/or contributed to the infringement of others by acts including, but not limited to, selling and/or importing products made using, or that include products made using, a process that includes all of the limitations of at least one of the claims of the '581 Patent, inducing others to sell or offer for sale such products, marketing the capabilities of such products, and providing, or making available, instructions, technical support, and/or other encouragement for the use of such products. For example, Samsung's Galaxy Z Flip5 smartphone includes Samsung's LPDDR5X DRAM and is advertised, sold, and supported by Samsung in partnership with third parties, including wireless network carriers.<sup>15</sup> On information

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<sup>15</sup> See Samsung, Galaxy Z Flip5, available at <https://www.samsung.com/us/smartphones/galaxy-z-flip5/>; see also Samsung Newsroom,

and belief, at least one distribution partner and/or customer has infringed one or more claims of the '581 Patent by selling, offering to sell, and/or using in the United States, or importing into the United States, products made using, or that include products made using, a Samsung process that infringes the '581 Patent.

62. On information and belief, Samsung has contributed to others practicing the '581 Patent. The Accused Products are not staple commodities of commerce and are not suitable for substantial non-infringing use. By providing the Accused Products, Samsung has contributed to the infringement of the '581 Patent by end users, such as customers, who use the Accused Products.

63. As a result of Samsung's infringing conduct, Harvard has suffered damages and will continue to suffer damages in an amount that, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by the Court under 35 U.S.C. § 284.

64. The analysis below demonstrates how an exemplary Samsung memory product is made using a process claimed by at least one claim of the '581 Patent. The claim and products analyzed below are exemplary and are not intended to limit Harvard's allegations. The analysis is based on information available to Harvard before discovery in this action. Harvard reserves the right to assert any additional claims of the '581 Patent against any infringing acts by Samsung.

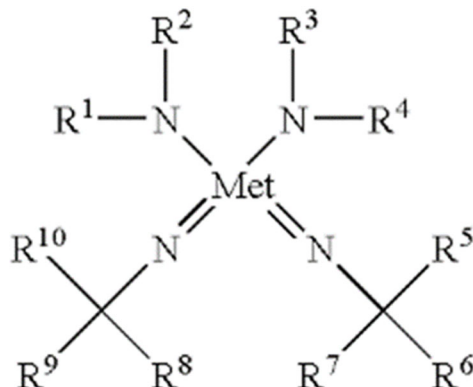
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*Samsung's LPDDR5X DRAM Validated for Use with Qualcomm Technologies' Snapdragon Mobile Platforms*, Mar. 2, 2022, available at <https://news.samsung.com/us/samsungs-lpddr5x-dram-validated-qualcomm-technologies-snapdragon/> (Samsung's Galaxy S22 smartphone also includes Samsung's LPDDR5X DRAM).

65. On information and belief, at least Samsung's fabrication of Samsung's LPDDR5X DRAM memory is made using a process that practices each element of at least claims 1 and 23 of the '581 Patent.

66. **Claim 1** recites:

A compounding having a formula



wherein Met is W or Mo, any one of R1 through R10 independently represent alkyl groups, arylalkyl groups, alkenylalkyl groups, alkynylalkyl groups, fluoroalkyl groups or alkyl groups substituted with other atoms or groups selected to enhance the volatility of the compound, where when Met is W and R2 and R4-R10 are methyl, then R1 and R3 are not both methyl or both ethyl, and when Met is Mo and R5-R10 are methyl, R1-R4 are not ethyl.

67. **Claim 23** recites:

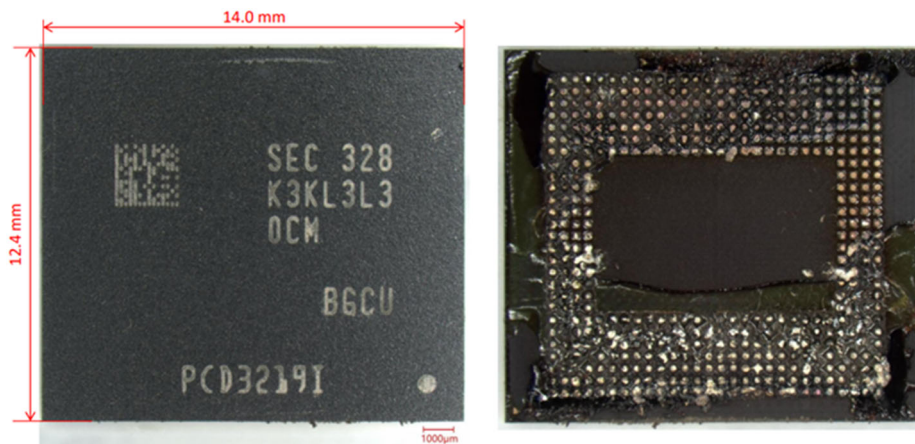
A process for depositing a material, the process comprising:

introducing a compound as claimed in claim 1 to a surface.

68. On information and belief, Samsung utilizes a process for depositing a material comprising introducing a compound as claimed in claim 1 to a surface. In particular, on information and belief, Samsung utilizes a process of depositing a film of tungsten (W) on a surface using a compound as claimed in claim 1 wherein Met is tungsten (W), as part of its

process of manufacturing memory chips, including the Samsung LPDDR5X DRAM memory chip.

69. The images below show a Samsung LPDDR5X DRAM memory chip.



70. Memory chips are microelectronic devices that include a series of cells to store information in bits. Memory chips, such as the one pictured above, include thin layers of tungsten.

71. The gates in the Samsung LPDDR5X DRAM memory chips, for example, include tungsten layers. The teardown images on the following page show gates from a Samsung LPDDR5X DRAM memory chip.

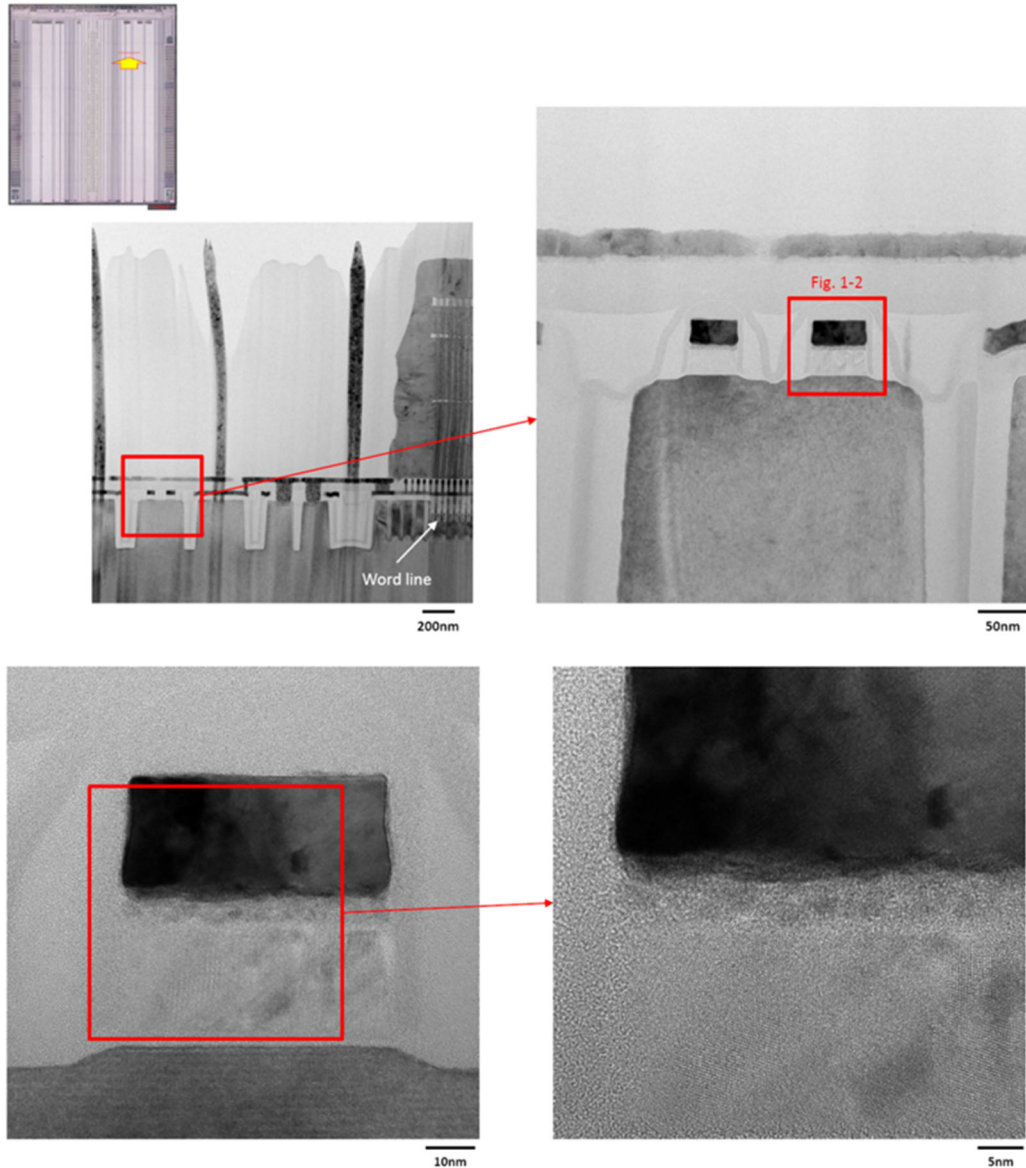
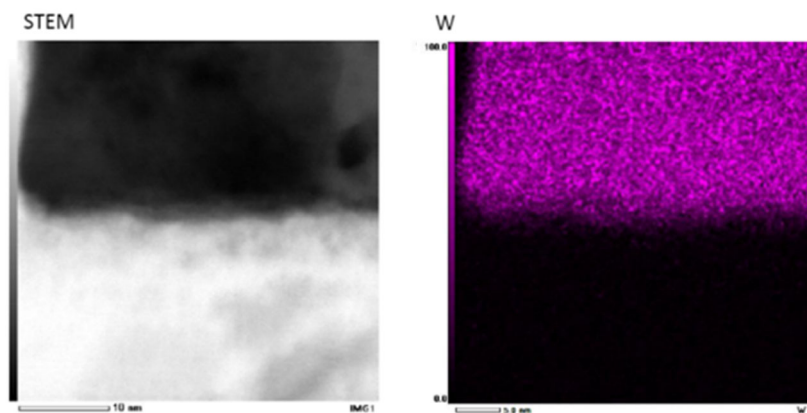
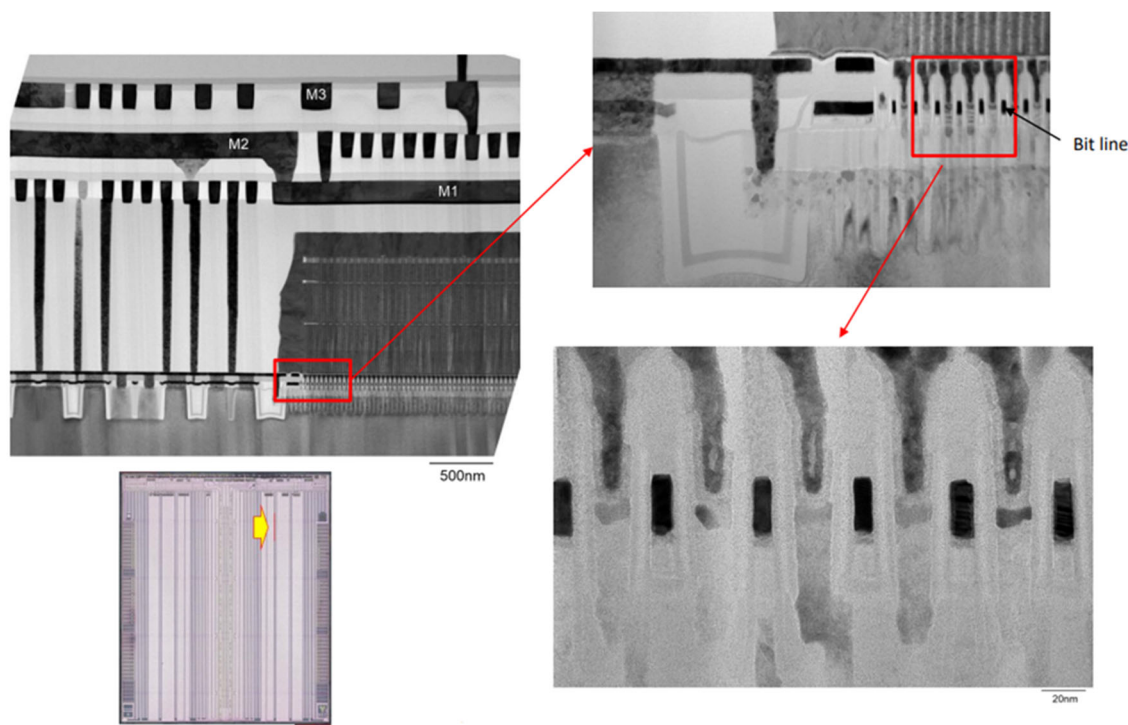


Fig. 1-2 Gate TEM observation

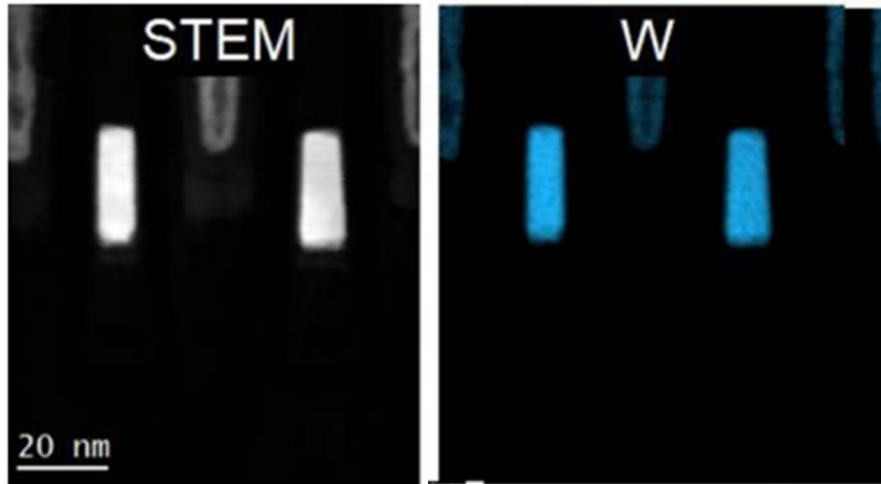
72. Transmission electron microscopy energy dispersive x-ray spectroscopy (TEM-EDX) analysis reveals that the layers in the Samsung LPDDR5X DRAM gate include tungsten (W) layers. This is shown in the figures on the following page and indicated by the magenta coloring (W).



73. The bitlines in the Samsung LPDDR5x DRAM memory chips, for example, also include tungsten layers. The teardown images below show bitlines from a Samsung LPDDR5X DRAM memory chip.



74. In the teardown images above, the bitline layers appear as a series of columns. Transmission electron microscopy electron energy loss spectroscopy (TEM-EELS) analysis reveals that the layers in the Samsung LPDDR5X DRAM bitlines include tungsten (W) layers. This is shown in the figures on the following page and indicated by the blue coloring (W).



75. On information and belief, the tungsten layers in the Samsung LPDDR5X DRAM are deposited using a tungsten compound as recited in claim 1. Samsung uses deposition processes in its fabrication processes.

76. The compound claimed in claim 1 may be used as a precursor for the deposition of tungsten layers.<sup>16</sup> Tungsten bis(alkylimide)bis(dialkylamide) as taught by the '581 Patent has the appropriate reactive properties of a precursor for the successful mass production of tungsten layers in semiconductor devices, such as memory, using a deposition method.

77. Thus, upon information and belief, the process utilized by Samsung for depositing a material, such as the tungsten layer, comprises introducing the compound as claimed in claim 1 to a surface, as utilized, for example, in the fabrication of LPDDR5X DRAM memory devices.

#### **PRAYER FOR RELIEF**

WHEREFORE, Harvard requests that the Court grant the following relief:

- A. A finding that Samsung has directly and/or indirectly infringed the Asserted Patents;

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<sup>16</sup> Roy G. Gordon, *ALD Precursors and Reaching Mechanisms in ATOMIC LAYER DEPOSITION FOR SEMICONDUCTORS* 15-46 (Cheol Seong Hwang ed., 2014).

- B. A finding that Samsung's infringement of the Asserted Patents is willful;
- C. An award to Harvard of royalty and/or lost profit damages adequate to compensate it for Samsung's infringement of the '189 and '581 Patents, including damages under 35 U.S.C. § 287, such damages to be determined by a jury;
- D. A permanent injunction against Samsung, its officers, agents, employees, and those persons in active concert or participation with it or any of them, and its successors and assigns, from continued acts of infringement of the Asserted Patents, including but not limited to being enjoined from making, using, selling, and/or offering for sale within the United States, and/or importing into the United States, any products that infringe the Asserted Patents; and
- E. An award to Harvard of such other and further relief as this Court deems just and proper.

**DEMAND FOR JURY TRIAL**

Plaintiff hereby demands a jury in accordance with Rule 38 of the Federal Rules of Civil Procedure.



Date: August 5, 2024

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\* *Pro hac vice* motion to be filed.

Respectfully submitted,

*/s/ William D. Belanger by permission*

*Charles Everingham IV*

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