

**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
Norfolk Division**

SEOUL SEMICONDUCTOR CO., LTD., a Korean corporation, SEOUL VIOSYS CO., LTD., a Korean corporation,)	
)	
)	
Plaintiff,)	
)	
v.)	Civil Action No. <u>2:22-cv-00156</u>
)	
Ace Hardware Corporation,)	JURY TRIAL DEMANDED
)	
Defendant.)	
)	
)	

COMPLAINT

Plaintiffs Seoul Semiconductor Co., Ltd. (“Seoul Semiconductor”) and Seoul Viosys Co., Ltd. (“Seoul Viosys”), (collectively the “Seoul Plaintiffs”) for their Complaint against Defendant Ace Hardware Corporation (“Ace Hardware”) allege as follows:

INTRODUCTION

1. The Seoul Plaintiffs bring this patent infringement action to protect their valuable patented technology relating to light emitting diodes (“LEDs”) and LED lighting. An LED is a semiconductor device that converts electrical energy into light. LEDs have many advantages over conventional light sources, including lower energy consumption, longer lifetime, and smaller size.

2. Seoul Semiconductor was founded in 1992 with approximately 30 employees in a small space of a commercial building in Bongchen-dong, Seoul, Korea. From those initial 30 employees, Seoul Semiconductor has grown into one of the largest manufacturers of LEDs in the world. It’s subsidiary, Seoul Viosys, is also a leading company in the LED industry.

3. The Seoul Plaintiffs' success is in large part due to their significant investment in innovation and respect for intellectual property. Seoul Semiconductor has invested in research and development ("R&D") for decades. Seoul Semiconductor invests over 10% of sales revenue into R&D and owns one of the largest LED patent portfolios in the world, which includes more than 10,000 patents worldwide.

THE PARTIES

4. Plaintiff Seoul Semiconductor is a company organized and existing under the laws of the Republic of Korea, with its principal place of business at 1B-25, 727, Wonsi-dong, Danwon-gu, Ansan-city, Gyeonggi-do, Korea 425-851.

5. Plaintiff Seoul Viosys is a company organized and existing under the laws of the Republic of Korea, with its principal place of business at 65-16, Sandan-ro 163 beon-gil, Danwon-gu, Ansan-city, Gyeonggi-do, Korea 425-851. Seoul Viosys is a subsidiary of Seoul Semiconductor.

6. Defendant Ace Hardware Corporation is a Delaware corporation. Ace Hardware Corporation is headquartered in Oak Brook, Illinois. According to the records of the Office of the Illinois Secretary of State, Ace Hardware Corporation currently is not in good standing in the State of Illinois.

7. Defendant Ace Hardware has physical locations in this Judicial District and Division, including a Redistribution Center located at 1006 CenterPoint Drive in Suffolk, Virginia. The Redistribution Center "serves as the organization's east coast hub for receiving import merchandise through the Port of Virginia." <https://newsroom.acehardware.com/ace-hardware-announces-expansion-plans-for-redistribution-center-in-suffolk-va/>. The Redistribution Center distributes products "to 10 of Ace Hardware's 14 Retail Support Centers, serving Ace retail stores

as far as Texas, New York and Florida.” *Id.* The Redistribution Center occupies an approximately 475,000 square foot warehouse within the Virginia Port Logistics Park in Suffolk, Virginia.



8. As alleged in more detail below, upon information and belief, Ace Hardware imports into the United States through the Port of Norfolk and elsewhere certain LED products that infringe the Seoul Plaintiffs’ patents. Ace then sells these infringing products to consumers located in the Eastern District of Virginia and other areas of the United States. One of those infringing products is the FEIT BPST19/LED(K) LED bulb. An image of the FEIT BPST19/LED(K) LED bulb is provided below.



9. Another infringing product that, upon information and belief, Ace Hardware imports into the United States through the Port of Norfolk and elsewhere and then sells to consumers located in the Eastern District of Virginia and other parts of the United States is the ACE A45085010KLED4/ACE LED bulb. An image of the ACE A45085010KLED4/ACE LED

bulb is provided below.



10. Yet another infringing product that, upon information and belief, Ace Hardware imports into the United States through the Port of Norfolk and elsewhere and then sells to consumers located in the Eastern District of Virginia and other parts of the United States is the GLOBE 91497 LED lighting device. An image of the GLOBE 91497 LED lighting device is provided below.



JURISDICTION AND VENUE

11. This Court has jurisdiction over the subject matter of this action under 28 U.S.C. §§ 1331 and 1338(a) because, at the very least, this action arises under the patent laws of the United States, including 35 U.S.C. § 271 *et seq.*

12. This Court has both general and specific personal jurisdiction over Ace Hardware.

Specifically:

- a) The defendant has committed acts within this district that give rise to this action, including importing and selling infringing products. Ace Hardware regularly receives imports of LEDs, lighting and/or lamps through the Port of Norfolk, Virginia. Between September 1, 2015 and April 8, 2022, Ace Hardware received at least 4,953 shipments through the Port of Norfolk, of which at least 209 shipments were identified by the shippers as containing LEDs, lamps and/or lighting (or a combination of these).
- b) The defendant has also regularly maintained and used physical facilities in this District to facilitate its infringing activities. These include a Redistribution Center located at 1006 CenterPoint Drive in Suffolk, Virginia. The Redistribution Center comprises an approximately 475,000 square foot warehouse within the Virginia Port Logistics Park in Suffolk, Virginia. In addition, Ace Hardware employs at least individuals within the Eastern District of Virginia, including Matt Massey, the manager of the import redistribution center located in Suffolk, Virginia. He oversees operations of the Import Redistribution Center facilities for Ace Hardware.

As a result of the above, Ace Hardware has sufficient contacts with this judicial district and the exercise of personal jurisdiction over Ace would not offend traditional notions of fair play and substantial justice.

13. Venue is properly laid in this judicial district pursuant to 28 U.S.C. §§1391(b) and (c) and 1400(b). As alleged above in greater detail (and incorporated herein), Ace Hardware has a physical presence in this judicial district and division and has committed acts of infringement in this district and division, including the importing of infringing products through the Port of Norfolk.

PATENTS-IN-SUIT

14. Seoul Viosys is the lawful owner of all right, title, and interest in United States Patent No. 7,572,653 entitled “**Method of fabricating light emitting diode**” (“**the ’653 patent**”), including the right to sue and to recover for infringement thereof. The ’653 patent was duly and legally issued on August 11, 2009, by the United States Patent and Trademark Office to Kim *et al.* A copy of the ’653 patent is attached hereto as **Exhibit A**.

15. Seoul Semiconductor is the lawful owner of all right, title, and interest in United States Patent No. 7,667,225 entitled “**Light emitting device**” (“**the ’225 patent**”), including the right to sue and to recover for infringement thereof. The ’225 patent was duly and legally issued on February 23, 2010, by the United States Patent and Trademark Office to Lee *et al.* A copy of the ’225 patent is attached hereto as **Exhibit B**.

16. Seoul Semiconductor is the lawful owner of all right, title, and interest in United States Patent No. 9,269,868 entitled “**Semiconductor light emitting element and method for manufacturing semiconductor light emitting element**” (“**the ’868 patent**”), including the right to sue and to recover for infringement thereof. The ’868 patent was duly and legally issued on February 23, 2016, by the United States Patent and Trademark Office to Kushibe *et al.* A copy of the ’868 patent is attached hereto as **Exhibit C**.

17. Seoul Semiconductor is the lawful owner of all right, title, and interest in United States Patent No. 8,604,496 entitled “**Optical semiconductor device**” (“**the ’496 patent**”), including the right to sue and to recover for infringement thereof. The ’496 patent was duly and legally issued on December 10, 2013, by the United States Patent and Trademark Office to Shioda *et al.* A copy of the ’496 patent is attached hereto as **Exhibit D**.

18. Seoul Semiconductor is the lawful owner of all right, title, and interest in United

States Patent No. 8,659,050 entitled “**Slim LED package**” (“**the ’050 patent**”), including the right to sue and to recover for infringement thereof. The ’050 patent was duly and legally issued on February 25, 2014, by the United States Patent and Trademark Office to Seo *et al.* A copy of the ’050 patent is attached hereto as **Exhibit E**.

19. Seoul Semiconductor is the lawful owner of all right, title, and interest in United States Patent No. 9,147,821 entitled “**Light emitting device**” (“**the ’821 patent**”), including the right to sue and to recover for infringement thereof. The ’821 patent was duly and legally issued on September 29, 2015, by the United States Patent and Trademark Office to Seo *et al.* A copy of the ’821 patent is attached hereto as **Exhibit F**.

20. Seoul Semiconductor is the lawful owner of all right, title, and interest in United States Patent No. 8,981,410 entitled “**Distributed Bragg reflector for reflecting light of multiple wavelengths from an LED**” (“**the ’410 patent**”), including the right to sue and to recover for infringement thereof. The ’410 patent was duly and legally issued on March 17, 2015, by the United States Patent and Trademark Office to Lin. A copy of the ’410 patent is attached hereto as **Exhibit G**.

21. Seoul Viosys is the lawful owner of all right, title, and interest in United States Patent No. 9,716,210 entitled “**Light Emitting Diode and Method of Fabricating the Same**” (“**the ’210 patent**”), including the right to sue and to recover for infringement thereof. The ’210 patent was duly and legally issued on July 25, 2017, by the United States Patent and Trademark Office to Kim *et al.* A copy of the ’210 patent is attached hereto as **Exhibit H**.

22. Seoul Semiconductor is the lawful owner of all right, title, and interest in United States Patent No. 10,134,967 entitled “**Light Emitting Device**” (“**the ’967 patent**”), including the right to sue and to recover for infringement thereof. The ’967 patent was duly and legally

issued on November 20, 2018, by the United States Patent and Trademark Office to Seo *et al.* A copy of the '967 patent is attached hereto as **Exhibit I**.

23. Seoul Semiconductor is the lawful owner of all right, title, and interest in United States Patent No. 7,397,069 entitled “**Semiconductor Device**” (“**the '069 patent**”), including the right to sue and to recover for infringement thereof. The '069 patent was duly and legally issued on July 8, 2008, by the United States Patent and Trademark Office to Tachibana *et al.* A copy of the '069 patent is attached hereto as **Exhibit J**.

24. The above referenced patents are collectively referred to herein as the “Seoul LED Patents.”

WILLFULNESS

25. On April 5, 2019, the Plaintiffs sent a letter to Ace Hardware notifying the company that it was importing, manufacturing, offering and/or selling certain products, including a non-dimmable LED bulb # A45085010KLED4/ACE, that infringed one or more of the Seoul LED Patents including the '821 Patent identified above. The Seoul Plaintiffs asked that Ace Hardware review the Seoul LED Patents to avoid any continuing infringement and respect Seoul's patent rights. Ace Hardware did not respond to this letter.

26. On June 5, 2019, the Seoul Plaintiffs sent another letter to Ace Hardware, this time to its counsel, asking that Ace Hardware stop selling products that infringe the Seoul LED Patents. Ace Hardware did not respond to this letter.

27. On December 2, 2019, the Seoul Plaintiffs sent another letter to Ace Hardware, again requesting that the company cease and desist selling the infringing product that had been identified previously. Ace Hardware did not respond to this letter.

28. On February 10, 2020, the Seoul Plaintiffs sent yet another follow up letter to Ace

Hardware. The Seoul Plaintiffs reiterated their concerns that Ace was selling products that infringe the Seoul LED Patents, including the bulb previously identified. Once again, Ace Hardware did not respond to this letter.

29. On May 4, June 18, July 21, and September 2, 2020, the Seoul Plaintiffs sent to Ace Hardware additional notice-of-infringement letters. Ace Hardware did not respond to any of those letters.

30. On November 30, 2020, the Seoul Plaintiffs sent to Ace Hardware another notice-of-infringement letter. At this time, not only was Ace Hardware continuing to sell the product previously identified as infringing, but also other infringing products. Notice of these additional infringing products— three different Globe bulbs and a Westinghouse bulb – was provided based on the '653 patent, the '210 patent, the '868 patent, and the '050 patent. The Seoul Plaintiffs stated in their letter that patent infringement is a very serious matter and, once again, requested that Ace Hardware stop offering and selling products that infringe one or more of the Seoul LED Patents. As before, Ace Hardware did not respond to this letter.

31. On February 1, 2021, the Seoul Plaintiffs sent to Ace Hardware another notice of infringement letter. The Seoul Plaintiffs noted that they had never received any substantive response to prior letters and that continuing to sell products that infringe the Seoul LED Patents could constitute willful infringement and subject Ace Hardware to treble damages in a patent litigation. The Seoul Plaintiffs asked yet again that Ace Hardware cease and desist selling infringing products.

32. On March 10, 2021, the Seoul Plaintiffs sent another letter to Ace Hardware's counsel regarding their numerous prior notices of infringement. Ace Hardware's counsel responded, but made no commitment to investigate the patents or accused products, did not

mention any analysis of infringement or validity, and made no agreement to stop selling infringing products.

33. On April 20, 2021, the Seoul Plaintiffs sent another letter pointing out that they still had not received any substantive response from Ace Hardware. The Seoul Plaintiffs pointed out that it is Ace Hardware's responsibility to ensure that its products do not infringe the patent rights of others and that continued sale of products that infringe their patents could constitute willful infringement. Ace Hardware did not respond to this letter.

34. On June 2, 2021, the Seoul Plaintiffs sent another letter to Ace Hardware, reminding the company of the prior notices of infringement. The Seoul Plaintiffs again asked that Ace Hardware stop selling infringing products. Ace Hardware did not respond to this letter.

35. On August 31, 2021, the Seoul Plaintiffs sent another letter to Ace Hardware once again asking that Ace Hardware respect the Seoul LED Patents and stop selling products that infringe. They asked that Ace Hardware "please cease and desist selling products that infringe Seoul's patents" and noted that it believed Ace's infringement to be willful at this point. Ace did not respond to this letter.

36. On September 16, 2021, the Seoul Plaintiffs sent a final letter summarizing its numerous notices of infringement to Ace Hardware and requesting one final time that Ace stop selling infringing products.

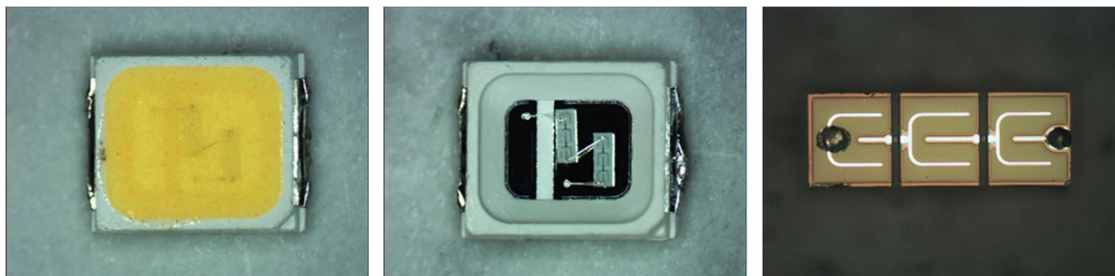
37. Despite this letter and the numerous other warning letters, on information and belief, Ace Hardware continues to import, offer to sell and sell the accused products described below.

38. The Seoul Plaintiffs have marked their patented products virtually in accordance with 35 U.S.C. § 287.

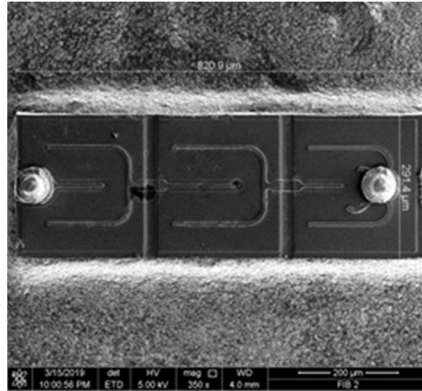
COUNT I
INFRINGEMENT OF U.S. PATENT NO. 7,572,653
EXEMPLARY CLAIM 1

39. Ace Hardware has infringed and continues to infringe at least exemplary claim 1 of the '653 patent by offering for sale, selling, using, and/or importing products within or into the United States, including at least the ACE A45085010KLED4/ACE LED bulb, made by a process that infringes, either literally or under the doctrine of equivalents, one or more claims of that patent in violation of 35 U.S.C. § 271(g).

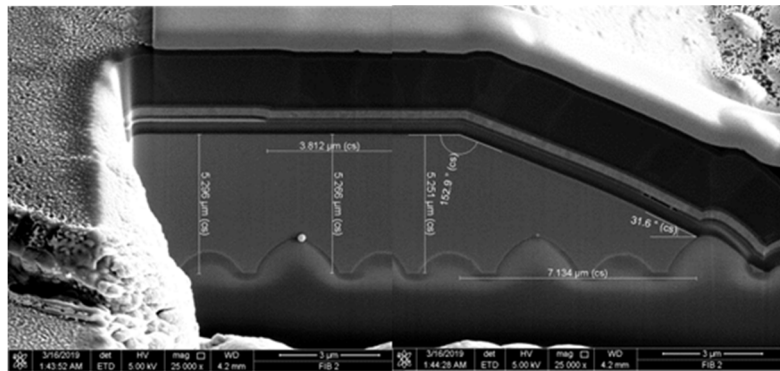
40. The ACE A45085010KLED4/ACE LED bulb includes an LED package comprising a light emitting diode ("LED") chip. The images of the LED package from the ACE A45085010KLED4/ACE LED bulb are reproduced below. The image below left shows the package after removal from the ACE A45085010KLED4/ACE LED bulb. The image below middle shows the package after removal of the resin encapsulant. The image below right shows the LED chip after removal from the package.



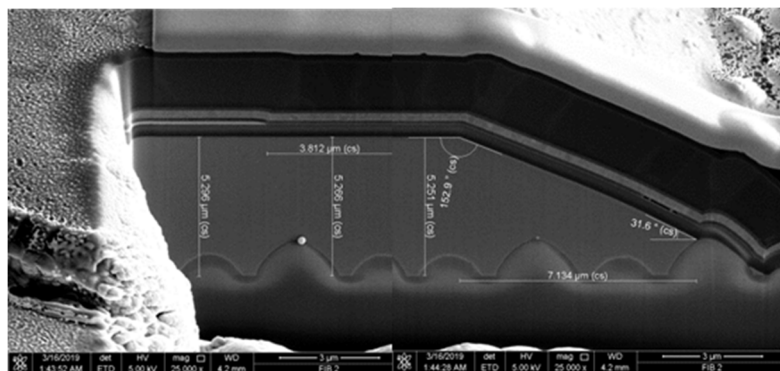
41. Upon information and belief, the LED chip is formed by practicing a method of fabricating a light emitting diode. The resulting light emitting diode is shown in the scanning electron optical microscope image reproduced below.



42. Upon information and belief, the method of fabricating a light emitting diode comprises a step of preparing a patterned substrate. The prepared substrate as it exists in the final product is shown in the scanning electron optical microscope image reproduced below.



43. Upon information and belief, the method of fabricating a light emitting diode further comprises the step of forming a lower semiconductor layer, an active layer, and an upper semiconductor layer on the substrate. The resulting layers are shown in the scanning electron optical microscope image reproduced below.



44. Upon information and belief, the method of fabricating a light emitting diode further comprises the step of forming an etching stop pattern on a portion of the semiconductor layer, forming a photoresist pattern over the upper semiconductor layer and the etching stop pattern such that a sidewall of the photoresist pattern is inclined to an upper surface of the substrate, sequentially etching the upper semiconductor layer, active layer and lower semiconductor layer using the photoresist pattern as an etching mask, and removing the photoresist pattern and the etching stop pattern.

45. Ace Hardware's infringement has caused and is continuing to cause damage and irreparable injury to Plaintiffs. Plaintiffs will continue to suffer damage and irreparable injury unless and until that infringement is enjoined by this Court, as a remedy at law alone would be inadequate.

46. Ace Hardware's infringement has occurred with knowledge of the '653 patent and knowledge that its acts constitute infringement. Ace Hardware's continuing conduct, therefore, is willful.

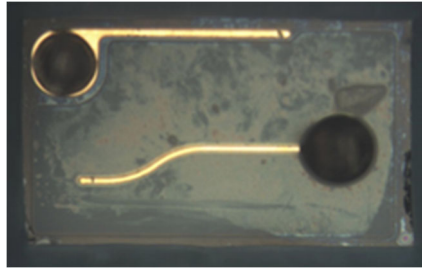
47. Plaintiffs are entitled to injunctive relief and damages in accordance with 35 U.S.C. §§ 271, 281, 283, and 284.

COUNT II
INFRINGEMENT OF U.S. PATENT NO. 7,667,225
EXEMPLARY CLAIM 1

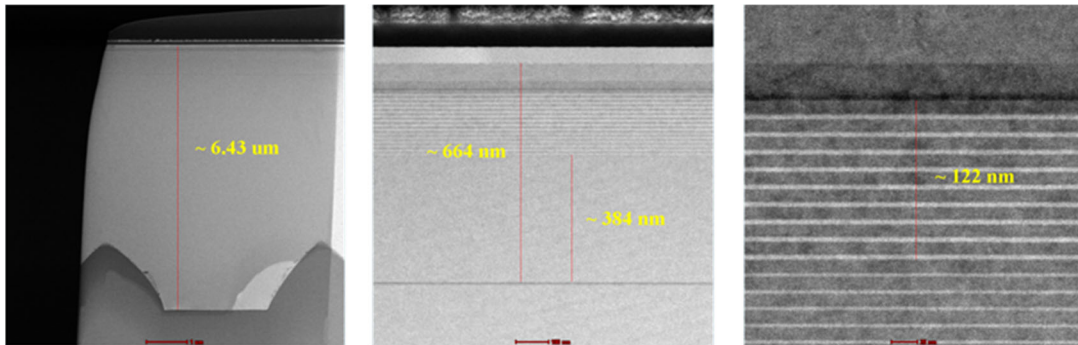
48. Ace Hardware has infringed and continues to infringe one or more claims of the '225 patent, including but not limited to exemplary claim 1, in violation of 35 U.S.C. § 271(a), at least by without authority making, using, offering to sell and/or selling the FEIT BPST19/LED(K) LED bulb within the United States or by importing through the Port of Norfolk and elsewhere the FEIT BPST19/LED(K) LED bulb into the United States.

49. The FEIT BPST19/LED(K) LED bulb includes a plurality of LED chips. An optical

image of an LED chip from the FEIT BPST19/LED(K) LED bulb is reproduced below.



50. Below are three transmission electron microscope images of the epitaxial structure of the LED chip. The image to the left shows the entire epitaxial structure above a patterned sapphire substrate. The image below middle enlarges the region of the epitaxial structure around the multi-quantum well active layer. The image below right enlarges the multi-quantum well. The LED chip includes from bottom to top in relevant part a substrate, an n-type semiconductor layer, a multi-quantum well structure, and a p-type semiconductor layer. The multi-quantum well structure comprises brightly colored wells separated by darker barriers.



51. The well layers within the multi-quantum well include indium. In addition, the concentration of indium varies across the layer, with areas of relatively high indium concentration transitioning to areas of lower indium concentration. The regions of relatively higher indium concentration correspond to carrier trap portions. And the transition from relatively lower to relatively higher indium concentration corresponds to a related drop in the band-gap energy.

52. Ace Hardware's infringement has caused and is continuing to cause damage and

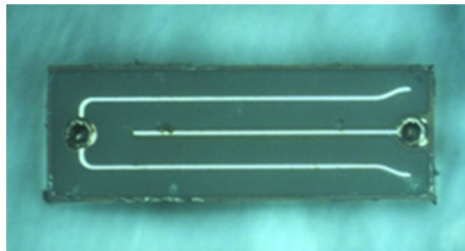
irreparable injury to Plaintiffs. Plaintiffs will continue to suffer damage and irreparable injury unless and until that infringement is enjoined by this Court, as a remedy at law alone would be inadequate.

53. Plaintiffs are entitled to injunctive relief and damages in accordance with 35 U.S.C. §§ 271, 281, 283, and 284.

COUNT III
INFRINGEMENT OF U.S. PATENT NO. 9,269,868
EXEMPLARY CLAIM 1

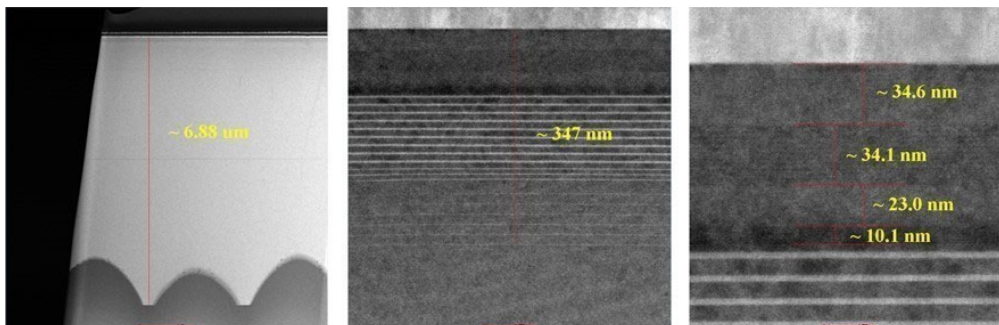
54. Ace Hardware has infringed and continues to infringe one or more claims of the '868 patent, including but not limited to exemplary claim 1, in violation of 35 U.S.C. § 271(a), at least by without authority making, using, offering to sell and/or selling the GLOBE 91497 LED lighting device within the United States or by importing through the Port of Norfolk and elsewhere the GLOBE 91497 LED lighting device into the United States.

55. The GLOBE 91497 LED lighting device includes a semiconductor light emitting element. An optical image of an example light emitting element is reproduced below.



56. Three transmission electron microscope images of the light emitting element are reproduced below. The image below left shows the full epitaxial structure above a patterned sapphire substrate. The center image indicates a plurality of layers including from bottom to top an n-type semiconductor layer, a light emitting unit, and a p-type semiconductor layer. The image below right focusses in on the p-type semiconductor layer. As the image shows, a number of layers as described above located below the p-type semiconductor layer, with the relative

brightness of each layer correlating with the dopant concentration. From bottom to top, the layers include a first layer, a second layer, and a third layer, each of which has different levels of the Magnesium doping, the first layer with relatively low Magnesium doping, the second layer with relatively high Magnesium doping, and the third layer with relatively intermediate Magnesium doping.



57. Ace Hardware's infringement has caused and is continuing to cause damage and irreparable injury to Plaintiffs. Plaintiffs will continue to suffer damage and irreparable injury unless and until that infringement is enjoined by this Court, as a remedy at law alone would be inadequate.

58. Ace Hardware's infringement has occurred with knowledge of the '868 patent and knowledge that its acts constitute infringement. Ace Hardware's continuing conduct, therefore, is willful.

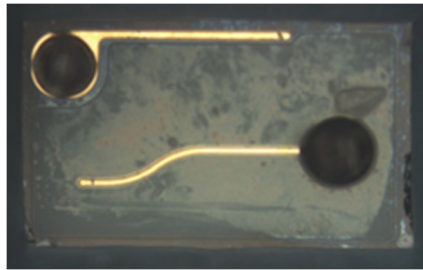
59. Plaintiffs are entitled to injunctive relief and damages in accordance with 35 U.S.C. §§ 271, 281, 283, and 284.

COUNT IV
INFRINGEMENT OF U.S. PATENT NO. 8,604,496
EXEMPLARY CLAIM 1

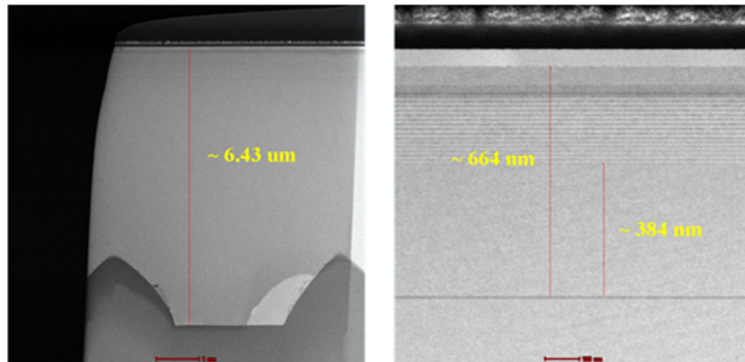
60. Ace Hardware has infringed and continues to infringe one or more claims of the '496 patent, including but not limited to exemplary claim 1, in violation of 35 U.S.C. § 271(a), at least by without authority making, using, offering to sell and/or selling the FEIT BPST19/LED(K)

LED bulb within the United States or by importing through the Port of Norfolk or elsewhere the FEIT BPST19/LED(K) LED bulb into the United States.

61. The FEIT BPST19/LED(K) LED bulb includes a plurality of LED chips. An optical image of an LED chip from the FEIT BPST19/LED(K) LED bulb is reproduced below.

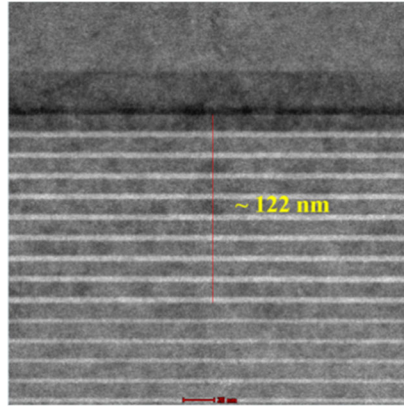


62. The images below are two transmission electron microscope images created from a thin section taken from the LED chip. The image below left shows a substrate toward the bottom of the image. The image below right is a higher resolution image focused on the light emitting layer formed above the substrate.



63. The layer structure in the image above right includes, in relevant part from bottom to top, an n-type semiconductor layer, a functional part, and a p-type semiconductor layer.

64. The image below is a transmission electron microscope image focused on the functional part, which includes a plurality of active layers stacked in a direction from the lower n-type semiconductor layer toward the upper p-type semiconductor layer.



65. The above depicted functional part includes multiple active layers that include a multilayer stacked body including a plurality of thick film layers and a plurality of thin film layers alternately stacked in the direction. The thin film layers appear as relatively bright and thin layers (wells) separated by relatively thick dimmer layers (barriers). A multilayer stacked body can include, for example, a pair of wells and three surrounding barrier layers.

66. Within the overall structure, the active layer includes an n-side barrier layer provided between the multilayer stacked body and the p-type semiconductor layer, a well layer; and a p-side barrier layer provided between the well layer and the p-type semiconductor layer. With that arrangement, the well layer is provided between the n-side barrier layer and the p-side barrier layer.

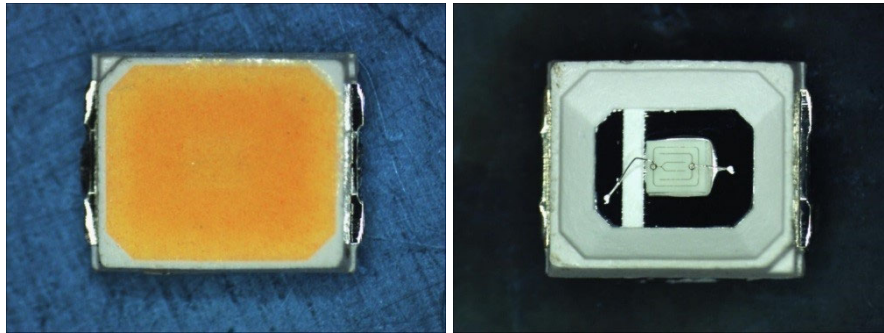
67. Ace Hardware's infringement has caused and is continuing to cause damage and irreparable injury to Plaintiffs. Plaintiffs will continue to suffer damage and irreparable injury unless and until that infringement is enjoined by this Court, as a remedy at law alone would be inadequate.

68. Plaintiffs are entitled to injunctive relief and damages in accordance with 35 U.S.C. §§ 271, 281, 283, and 284.

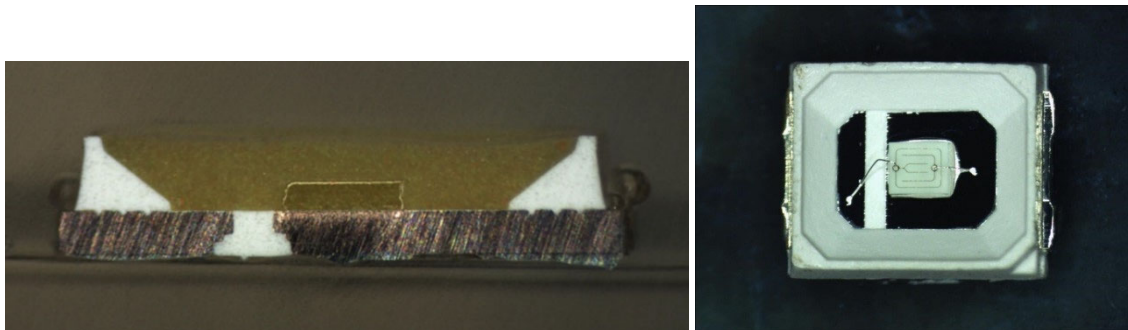
COUNT V
INFRINGEMENT OF U.S. PATENT NO. 8,659,050
EXEMPLARY CLAIM 1

69. Ace Hardware has infringed and continues to infringe one or more claims of the '050 patent, including but not limited to exemplary claim 1, in violation of 35 U.S.C. § 271(a), at least by without authority making, using, offering to sell and/or selling the GLOBE 91497 LED lighting device within the United States or by importing through the Port of Norfolk and elsewhere the GLOBE 91497 LED lighting device into the United States.

70. The GLOBE 91497 LED lighting device includes a plurality of LED packages. Optical microscope images of an LED package from the GLOBE 91497 LED lighting device are reproduced below before and after removal of an encapsulant.



71. The image below left is an optical microscope image of a cross-section through an LED package from the GLOBE 91497 LED lighting device.



72. The above cross-sectional image also shows first (right) and second (left) lead frames that are spaced apart from each other. The cross-sectional also shows that at least part of

the surfaces of the first and second lead frames are covered by a yellow resin, In addition, the rectangular outline of an LED chip is shown disposed on upper surface of the first lead frame in both images above. An electrical connection between the LED and the second (left) lead frame is visible in the image above right.

73. The above cross-sectional also shows that both lead frames include a groove formed thereon, the resin is formed in the groove; and the groove comprises a plurality of sub-grooves, each sub-groove having a triangular cross-section.

74. Ace Hardware's infringement has caused and is continuing to cause damage and irreparable injury to Plaintiffs. Plaintiffs will continue to suffer damage and irreparable injury unless and until that infringement is enjoined by this Court, as a remedy at law alone would be inadequate.

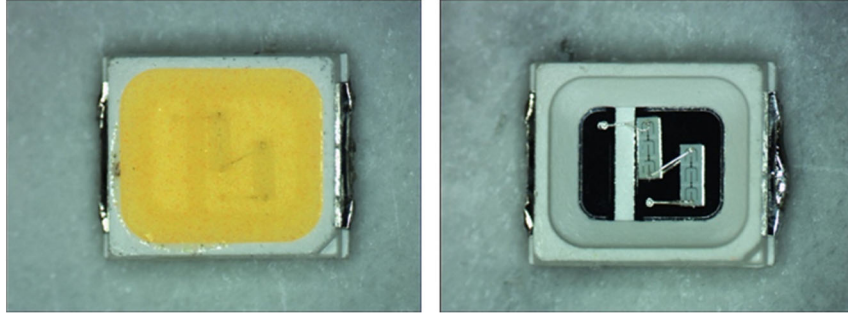
75. Ace Hardware's infringement has occurred with knowledge of the '050 patent and knowledge that its acts constitute infringement. Ace Hardware's continuing conduct, therefore, is willful.

76. Plaintiffs are entitled to injunctive relief and damages in accordance with 35 U.S.C. §§ 271, 281, 283, and 284.

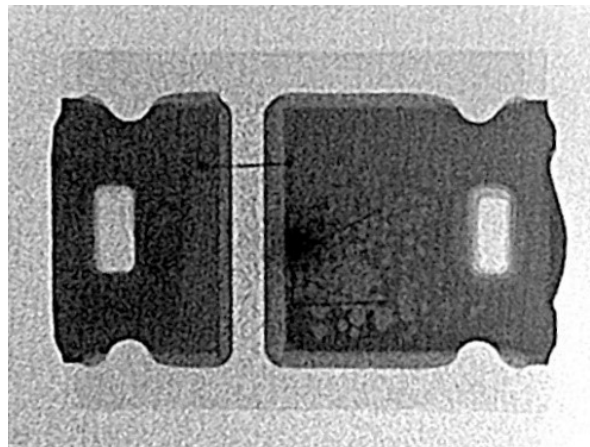
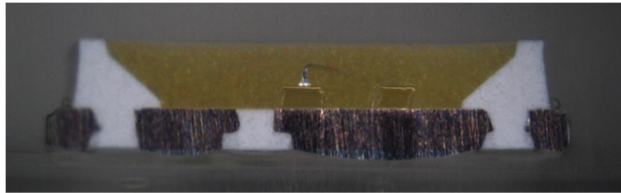
COUNT VI
INFRINGEMENT OF U.S. PATENT NO. 9,147,821
EXEMPLARY CLAIM 1

77. Ace Hardware has infringed and continues to infringe one or more claims of the '821 patent, including but not limited to exemplary claim 1, in violation of 35 U.S.C. § 271(a), at least by without authority making, using, offering to sell and/or selling the ACE A45085010KLED4/ACE LED bulb within the United States or by importing through the Port of Norfolk and elsewhere the ACE A45085010KLED4/ACE LED bulb into the United States.

78. The ACE A45085010KLED4/ACE LED bulb includes a plurality of LED packages. Optical microscope images of an LED package from the ACE A45085010KLED4/ACE LED bulb are reproduced below before and after removal of an encapsulant.



79. The top image below is an optical microscope image of a cross-section through an LED package ACE A45085010KLED4/ACE LED bulb. The bottom image below is an x-ray through the package.



80. As the above images show, the LED package contains two lead frames spaced apart from each other. The optical microscope image show that each lead frames has an upper portion and a lower portion. Two LED chips are disposed on the upper portion of the right lead frame in

the optical image.

81. The cross-section image above depicts the cross-sectional shape of the sidewalls of both lead frames at the sides that face each other in the horizontal direction. In addition, the upper portion of the left and right lead frames extend further into the space between the lead frames than the lower portion of the left and right lead frames. That the upper portions extend further into the space than the lower portions indicates the upper and lower portions have different planar shapes from each other. This same feature is also depicted in the x-ray image above. In particular, both leads are shown with relatively dark central portions and relatively light outer portions. The differences in brightness correlate to the thickness of the metal at those locations. The relatively light outer portions have different planar shapes than the relatively dark central portions.

82. As discussed above, since the upper portions extends further into the space than the lower portions, the sidewalls of both lead frames comprise an inset sidewall partially defining an outer fixing space. And also a planar area of the outer fixing space disposed between the second portions is smaller than a planar area of the outer fixing space disposed between the first portions.

83. Ace Hardware's infringement has caused and is continuing to cause damage and irreparable injury to Plaintiffs. Plaintiffs will continue to suffer damage and irreparable injury unless and until that infringement is enjoined by this Court, as a remedy at law alone would be inadequate.

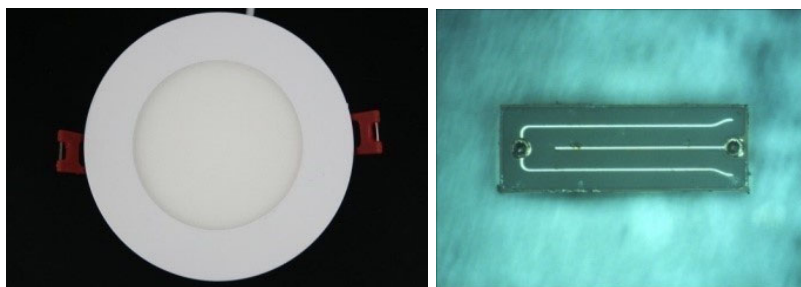
84. Ace Hardware's infringement has occurred with knowledge of the '821 patent and knowledge that its acts constitute infringement. Ace Hardware's continuing conduct, therefore, is willful.

85. Plaintiffs are entitled to injunctive relief and damages in accordance with 35 U.S.C. §§ 271, 281, 283, and 284.

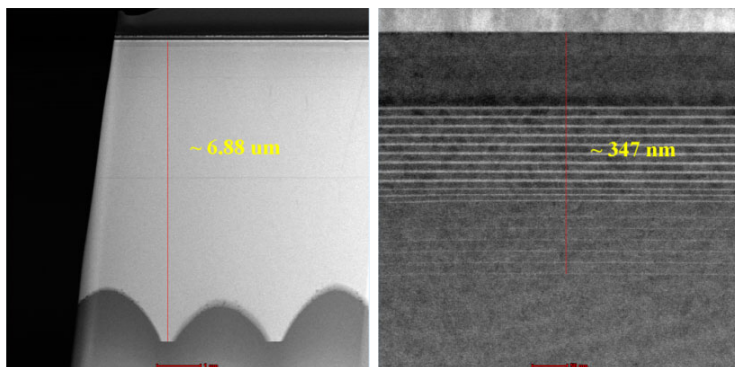
COUNT VII
INFRINGEMENT OF U.S. PATENT NO. 8,981,410
EXEMPLARY CLAIM 1

86. Ace Hardware has infringed and continues to infringe one or more claims of the '410 patent, including but not limited to exemplary claim 1, in violation of 35 U.S.C. § 271(a), at least by without authority making, using, offering to sell and/or selling the GLOBE 91497 LED lighting device within the United States or by importing through the Port of Norfolk and elsewhere the GLOBE 91497 LED lighting device into the United States.

87. The images below show the GLOBE 91497 LED lighting device and a light emitting diode device that was removed from the GLOBE 91497 LED lighting device.

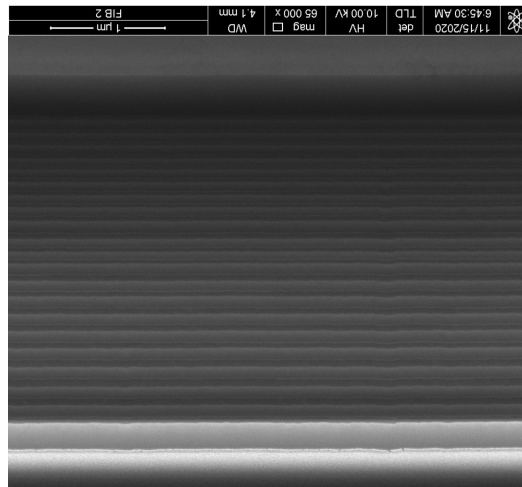


88. The images below are two transmission electron microscope images created from a thin section taken from the light emitting diode device. The image below left shows a substrate toward the bottom of the image. The image below right is a higher resolution image focused on the active layer formed above the substrate.



89. The image below is scanning electron optical microscope image created from a thin

section taken from the light emitting diode device. The image is focused on a layer structure formed below the back surface of the substrate (which appears at the top of the image below). The layer structure shown in the image below includes, in relevant part starting from the top, the substrate, a low-index total internal reflection layer, and a distributed Bragg reflector (DBR). The low-index total internal reflection layer comprises a relatively thick layer of silicon dioxide disposed between the substrate and the DBR.



90. The DBR is comprised of interleaved layers of the high index dielectric titanium dioxide and low index dielectric silicon dioxide. The titanium dioxide layers appear as relatively light and thin layers relative to the silicon dioxide layers. As the image shows, the upper layers of the DBR comprise a first plurality of periods where the high index material layers have a first thickness and the low index materials have a second thickness. The image also shows that the lower layers of the DBR comprise a second plurality of periods where the high index material layers have a third thickness and the low index materials have a fourth thickness.

91. Ace Hardware's infringement has caused and is continuing to cause damage and irreparable injury to Plaintiffs. Plaintiffs will continue to suffer damage and irreparable injury unless and until that infringement is enjoined by this Court, as a remedy at law alone would be

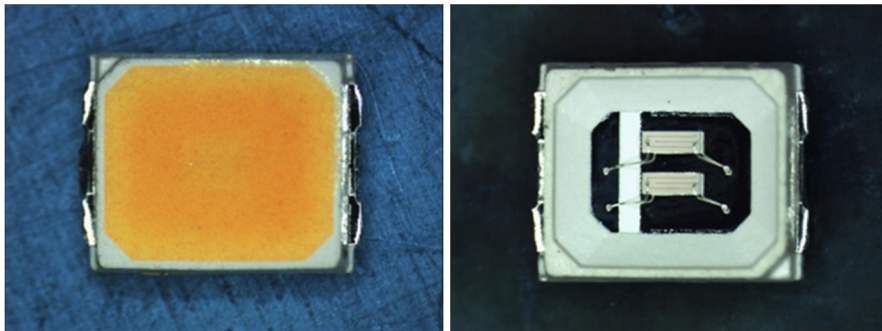
inadequate.

92. Plaintiffs are entitled to injunctive relief and damages in accordance with 35 U.S.C. §§ 271, 281, 283, and 284.

COUNT VIII
INFRINGEMENT OF U.S. PATENT NO. 9,716,210
EXEMPLARY CLAIM 1

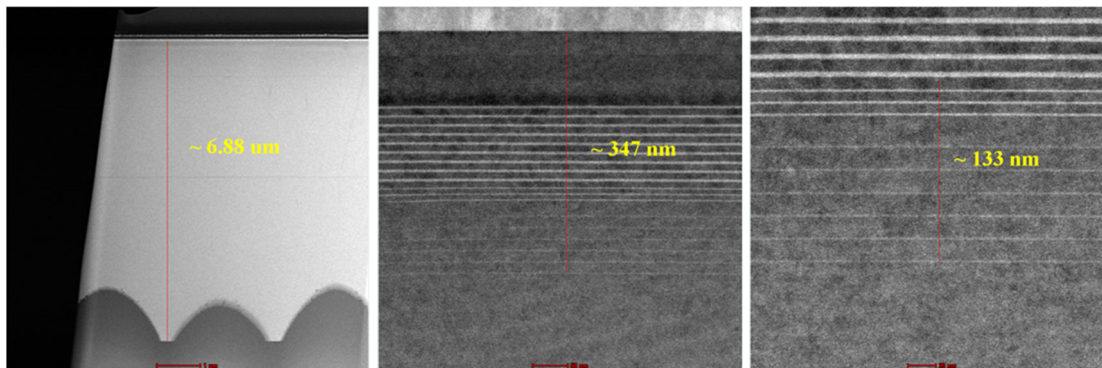
93. Ace Hardware has infringed and continues to infringe one or more claims of the '210 patent, including but not limited to exemplary claim 1, in violation of 35 U.S.C. § 271(a), at least by without authority making, using, offering to sell and/or selling the GLOBE 91497 LED lighting device within the United States or by importing through the Port of Norfolk and elsewhere the GLOBE 91497 LED lighting device into the United States.

94. The GLOBE 91497 LED lighting device includes a plurality of LED packages, each of which includes a light emitting diode. The image of an LED package from the GLOBE 91497 LED lighting device is reproduced below left. The image below right shows LED chips within package.



95. Below are three transmission electron microscope images of the epi-structure of the LED chip. The image to the left shows the entire epi-structure above a patterned sapphire substrate. The image below middle enlarges the region of the epi-structure around the multi-quantum well active layer. The image below right enlarges the region under the active region. The epi-structure includes from top to bottom in relevant part a p-type contact layer, a multi-quantum well active

region, and an n-type contact layer. The active region, which appears as a relatively bright repeating pattern of Indium doped layers separated by relatively dark barrier layers near the center of the image. Below the active region is a superlattice layer, which includes a plurality of layers, and appears as a relatively faint and closely spaced pattern. Below the superlattice is a spacer layer, which includes a plurality of layers, and appears as a relatively faint and widely spaced pattern



96. Based on the level of Indium doping in the active region, the superlattice layer, and the spacer layer, the spacer layer will have a bandgap smaller than the barrier layers of the multi-quantum well, but higher than the bandgap of the quantum well layers.

97. Ace Hardware's infringement has caused and is continuing to cause damage and irreparable injury to Plaintiffs. Plaintiffs will continue to suffer damage and irreparable injury unless and until that infringement is enjoined by this Court, as a remedy at law alone would be inadequate.

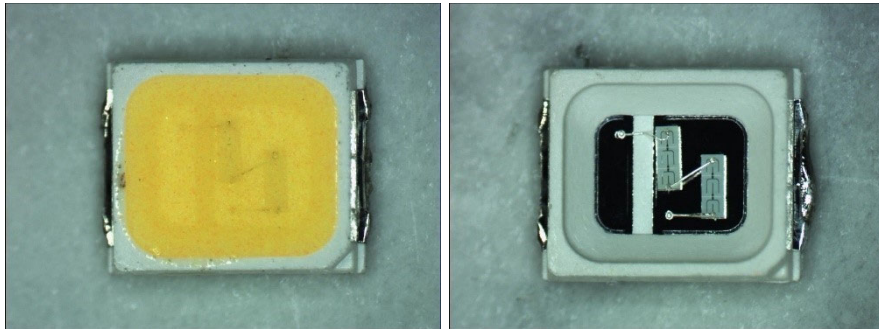
98. Ace Hardware's infringement has occurred with knowledge of the '210 patent and knowledge that its acts constitute infringement. Ace Hardware's continuing conduct, therefore, is willful.

99. Plaintiffs are entitled to injunctive relief and damages in accordance with 35 U.S.C. §§ 271, 281, 283, and 284.

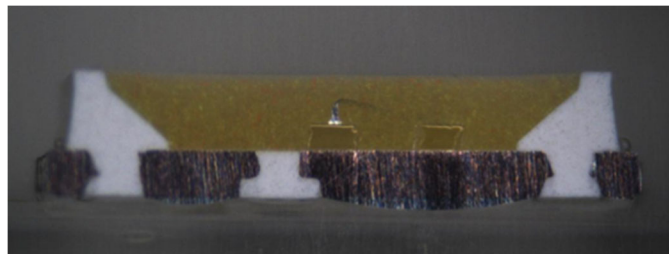
COUNT IX
INFRINGEMENT OF U.S. PATENT NO. 10,134,967
EXEMPLARY CLAIM 17

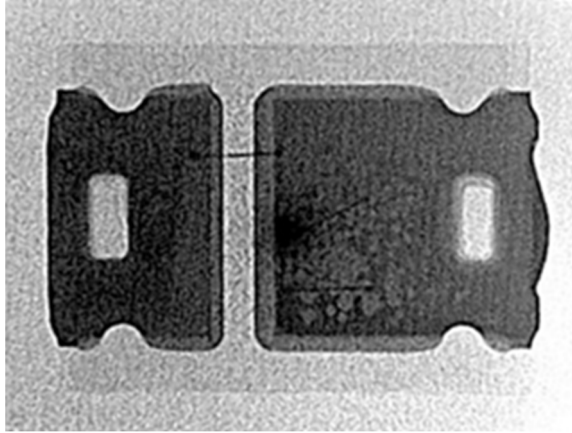
100. Ace Hardware has infringed and continues to infringe one or more claims of the '967 patent, including but not limited to exemplary claim 17, in violation of 35 U.S.C. § 271(a), at least by without authority making, using, offering to sell and/or selling the ACE A45085010KLED4/ACE LED bulb within the United States or by importing through the Port of Norfolk and elsewhere the ACE A45085010KLED4/ACE LED bulb into the United States.

101. The ACE A45085010KLED4/ACE LED bulb includes a plurality of LED packages. Optical microscope images of an LED package from the ACE A45085010KLED4/ACE LED bulb are reproduced below before and after removal of an encapsulant.



102. The top image below is an optical microscope image of a cross-section through the LED package. The bottom image below is an x-ray through the package.





103. As the above images show, the LED package contains two metal lead frames spaced apart from each other. The optical image shows that each lead frame has a substantially flat top surface, a bottom surface, a fixing hole, and sidewalls between the top and bottom surfaces. LED chips are disposed on the top surface of the right lead frame in the optical image.

104. The cross-section image above depicts the cross-sectional shape of the sidewalls of both lead frames at the sides that face each other in the horizontal direction. In addition, the upper surface of the left and right lead frames extend further into the space between the lead frames than the bottom surface of the left and right lead frames. That the top surfaces extend further into the space indicates an undercut in the sidewall that partially defines a fixing space between the two lead frames. This same feature is also depicted in the x-ray image above. In particular, both leads are shown with relatively dark interior regions and three sides have relatively light outer regions. The differences in brightness correlate to the thickness of the metal at those locations. The relatively light outer regions correspond to undercut sidewalls on three sides of both lead frames. The undercuts form the fixing space.

105. As discussed above and as shown in the images above, the first and second lead frames include a fixing hole located in the interior portions and each fixing hole includes an undercut sidewall that envelopes inner bounds of the fixing hole.

106. As discussed above, the lead frames face each other in the horizontal direction and both lead frames have three undercut sidewalls as indicated by the cross-sectional and x-ray images above. Of those three undercut sidewalls, each lead frame has a sidewall shown as extending vertically in the x-ray image and two sidewalls shown as extending horizontally. The sidewalls extending horizontally in the x-ray image are all parallel and also perpendicular to those shown extending vertically.

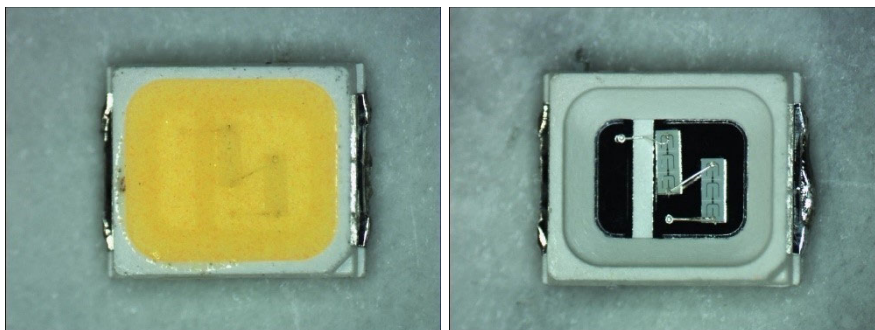
107. Ace Hardware's infringement has caused and is continuing to cause damage and irreparable injury to Plaintiffs. Plaintiffs will continue to suffer damage and irreparable injury unless and until that infringement is enjoined by this Court, as a remedy at law alone would be inadequate.

108. Plaintiffs are entitled to injunctive relief and damages in accordance with 35 U.S.C. §§ 271, 281, 283, and 284.

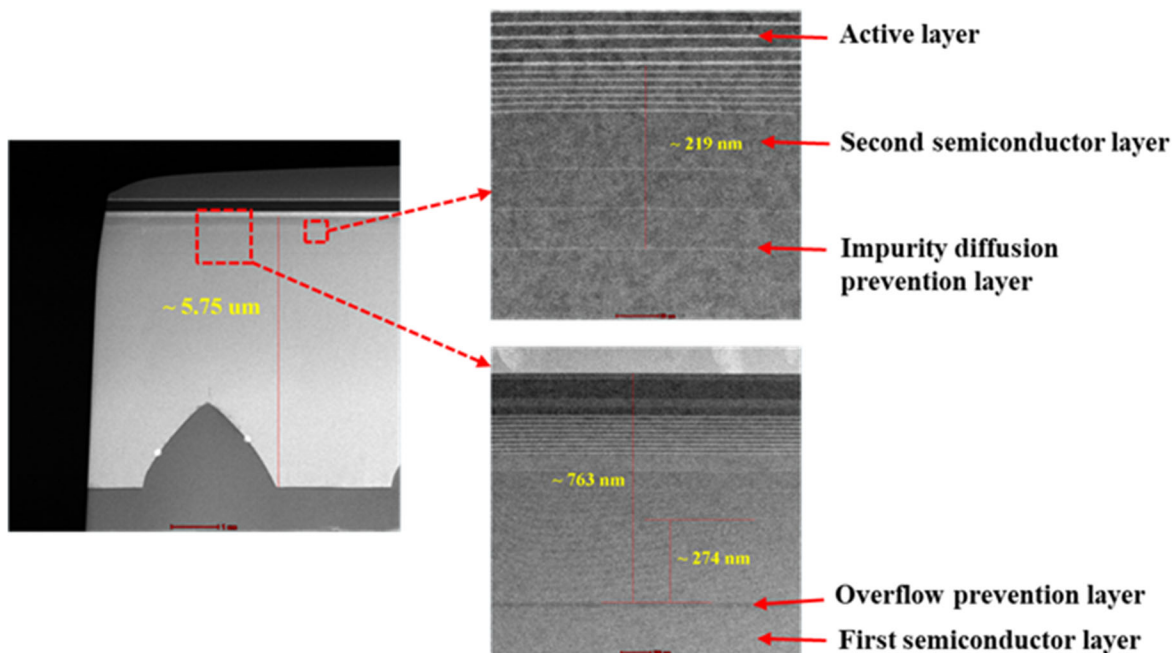
COUNT X
INFRINGEMENT OF U.S. PATENT NO. 7,397,069
EXEMPLARY CLAIM 1

109. Ace Hardware has infringed and continues to infringe one or more claims of the '891 patent, including but not limited to exemplary claim 1, in violation of 35 U.S.C. § 271(a), at least by without authority making, using, offering to sell and/or selling the ACE A45085010KLED4/ACE LED bulb within the United States or by importing through the Port of Norfolk and elsewhere the ACE A45085010KLED4/ACE LED bulb into the United States.

110. The A45085010KLED4/ACE LED bulb includes a plurality of LED packages. Optical microscope images of an LED package from the ACE A45085010KLED4/ACE LED bulb are reproduced below before and after removal of an encapsulant.



111. The below images were created using a transmission electron microscope (TEM) of a semiconductor device (light emitting diode) after removal from the package. The TEM images indicate the presence of a plurality of gallium-nitride-based layers. Those layers include, in relevant part, from top to bottom: an active layer comprising a multi-quantum well, a second semiconductor layer doped with the negative dopant silicon, an impurity diffusion prevention layer having a relatively high indium concentration and relatively low concentration of aluminum, an overflow prevention layer having the negative dopant silicon and a relatively high concentration of aluminum, and first semiconductor layer containing the negative dopant silicon. The indium and aluminum concentrations of the impurity prevention layer, which respectively correlate directly and indirectly with the brightness of the layers, indicate a band gap smaller than those of the overflow prevention layer, the first semiconductor layer and the second semiconductor layer.



112. Ace Hardware’s infringement has caused and is continuing to cause damage and irreparable injury to Plaintiffs. Plaintiffs will continue to suffer damage and irreparable injury unless and until that infringement is enjoined by this Court, as a remedy at law alone would be inadequate.

113. Plaintiffs are entitled to injunctive relief and damages in accordance with 35 U.S.C. §§ 271, 281, 283, and 284.

PRAYER FOR RELIEF

WHEREFORE, the Seoul Plaintiffs requests that the Court enter judgment in their favor and against Defendant Ace Hardware Corporation, as follows:

A. A judgment that Defendant infringe the ’653, ’225, ’868, ’496, ’050, ’821, ’410, ’210, ’967 and ’069 patents;

B. A preliminary and permanent injunction restraining and enjoining Defendant, its officers, partners, agents, servants, employees, parents, subsidiaries, divisions, affiliate corporations, joint ventures, other related business entities and all other persons acting in concert,

participation, or in privity with them, and their successors and assigns, from infringing the '653, '225, '868, '496, '050, '821, '410, '210, '967 and '069 patents;

C. An award of damages to Plaintiffs Seoul Semiconductor and Seoul Viosys arising from Defendant's past and continuing infringement up until the date Defendant is finally and permanently enjoined from further infringement, including compensatory damages;

D. A determination that Defendants' infringement of one or more of the '653, '225, '868, '496, '050, '821, '410, '210, '967 and '069 patents was willful, and a trebling of damages pursuant to 35 U.S.C. § 284;

E. A determination that this is an exceptional case and awarding the Seoul Plaintiffs attorneys' fees pursuant to 35 U.S.C. § 285; An order awarding the Seoul Plaintiffs the costs and expenses that they have incurred in prosecuting this action;

F. An order awarding the Seoul Plaintiffs pre- and post-judgment interest on their damages; and

G. Such other and further relief in law or in equity as this Court deems just and proper.

JURY DEMAND

Plaintiffs Seoul Semiconductor and Seoul Viosys respectfully request a jury trial on all issues so triable.

April 15, 2022

Respectfully submitted,

HAUSFELD, LLP

/s/ Walter D. Kelley, Jr. _____

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