

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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CREE, INC.

Petitioner

v.

DOCUMENT SECURITY SYSTEMS, INC.

Patent Owner

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Patent 7,256,486

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**DECLARATION OF YUJI ZHAO, PH.D.**

**MAIL STOP PATENT BOARD**

Patent Trial and Appeal Board

United States Patent & Trademark Office

P.O. Box 1450

Alexandria, Virginia 22313-1450

I, Dr. Yuji Zhao, Ph.D. declare as follows:

## **I. INTRODUCTION**

1. I am over the age of twenty one (21) and am competent to make this Declaration. I reside in the State of Arizona at 973 West Nolan Way, Chandler, Arizona, 85248.

2. I am a university professor at Arizona State University and also conduct consulting in light emitting diodes (“LED”) including design and packaging, semiconductor devices, and power electronics.

### **A. Engagement**

3. I have been retained by counsel for Cree, Inc. in the above-captioned *Inter Partes* Review (“IPR”) matter as an independent technical expert.

4. As part of this engagement, I have been retained to review and evaluate whether certain patents and publications disclose to a person of ordinary skill in the art (“POSA”) the subject matter of specific claims of United States Patent No. 7,256,486 (“the ‘486 patent”) as of the time of the filing date of the ‘486 patent. I expect to testify regarding the matters set forth in this declaration if asked to do so.

5. I am being compensated on an hourly basis for my work performed in connection with this case. I have received no additional compensation for my

work in this case, and my compensation does not depend upon the contents of this report, any testimony I may provide, or the ultimate outcome of the case.

**B. Background and Qualifications**

6. I have a B.S. in Microelectronics from Fudan University, and an M.S. and Ph.D. in Electrical and Computer Engineering from University of California Santa Barbara (UCSB).

7. I have about 10 years of experience in the area of GaN light-emitting diodes (LEDs), where I am widely recognized as a leader in the LED field. I have extensive, hands-on experience with LEDs, including epitaxial growth, device fabrication, and packaging. I have served as an Assistant Professor in Electrical Engineering, and I have taught many undergraduate and graduate classes on semiconductor optoelectronics, including LED fabrication and packaging. In addition, I have given numerous invited lectures and seminars on LED devices and packaging technologies for many of the world's leading LED companies, academic institutes, and professional organizations, such as HC SemiTek, MIT, Stanford University, and IEEE.

8. For my graduate studies, I worked with Prof. Shuji Nakamura at UCSB, who is widely-regarded as the inventor of GaN LEDs and received the Nobel Prize in Physics “for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources.” While at UCSB,

I was a key researcher and a project leader in the Solid State Lighting and Energy Center (SSLEC), which is the world's leading research center for LEDs with an annual research budget of over \$5M. I have personally fabricated, tested, and packaged hundreds of LED devices. I developed improvements to LED packaging structures, and I also analyzed various packing structures including commercial structures from companies such as CREE and Philips Lumileds, as well as a UCSB patented structure "transparent LED packaging". While at UCSB, I also developed the world's best GaN blue LEDs with record efficiency at high current densities out to 400A/cm<sup>2</sup>. This work led to the filing of several patent applications, over 100 media reports in six languages (including highlights in Science, Semiconductor Today, and Yahoo), and numerous papers and invited conference presentations, along with recognition from the SSLEC in years 2010 through 2012 with the "Outstanding Research Achievement Award."

9. After my Ph.D., I continued my research on LEDs as an Assistant Professor at Arizona State University, where I am currently employed. I am the founder and Director of GaN Device Research Group at Arizona State University, which is funded by DoD, DOE, NASA, SFAz (Science Foundation of Arizona). The focus of the research group is on GaN devices including LEDs. This research group engages over five faculty members, and over twenty postdoctoral researchers and graduate students, and is one of the largest GaN research

laboratories in the US, including state of the art equipment and methods to fabricate, analyze and test LED devices and packages.

10. I am a member of two of the largest professional engineering societies: the Institute of Electrical and Electronics Engineers, Inc. (“IEEE”) and the Materials Research Society (“MRS”). These professional societies address, among other things, LED materials, devices, and packaging.

11. I have served on various conference committees (invited to participate) on leading semiconductor device conferences, including the International Symposium on Semiconductor Light Emitting Devices (ISSLED), the US Workshop on Organometallic Vapor Phase Epitaxy (OMVPE), and the Lester Eastman Conference on High Performance Devices (LEC). All of these conferences have large LED sessions.

12. I have written two book chapters on LEDs and over 100 journal and conference publications on various subjects related to semiconductor devices, among which over 50 publications are directly on LEDs. The majority of these publications involve packaged LEDs. Some of my publications (articles and book chapters) on LEDs include:

- H. Fu and Y. Zhao, “Efficiency Droop in InGaN/GaN LEDs”, Book Chapter in “Nitride Semiconductor Light-Emitting Diodes”, 2nd edition, Elsevier, (2017);
- C. Y. Huang, Y. Zhao, Y. R. Wu, and J. S. Speck, “Nonpolar and

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