IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Nulty, et al.
U.S. Patent No.:	6,784,552
Issue Date:	August 31, 2004
Appl. Serial No.:	09/540,610
Filing Date:	March 31, 2000
Title:	STRUCTURE HAVING REDUCED LATERAL SPACER EROSION

DECLARATION OF DR. VIVEK SUBRAMANIAN

I, Vivek Subramanian, of Berkeley, California, declare that:

1. I have been retained by counsel for Petitioner SK hynix, Inc. to provide my independent analysis of the issues raised in the petition for *inter partes* review of U.S. Patent No. 6,784,552 ("the '552 Patent").

2. I am not currently and have not at any time in the past been an employee of SK hynix, Inc., SK hynix America, Inc.; SK hynix Memory Solutions, Inc.; and Hynix Semiconductor Manufacturing America, Inc.

3. I am being compensated for my time expended in connection with this matter at the rate of $600 per hour, plus reimbursement of any expenses I incur. I have no financial stake in this matter, and my compensation is not contingent upon the outcome of this *inter partes* review of the '552 Patent.

I. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

4. I am an expert in the fields of semiconductor design and semiconductor fabrication, among other fields. I have over 19 years of experience as a practicing engineer, researcher, technical manager and educator in these fields.

5. I received a Bachelor's degree summa cum laude in electrical engineering from Louisiana State University in 1994, and an M.S. and Ph.D. in electrical engineering, in 1996 and 1998, respectively, from Stanford University. During my tenure as a graduate student at Stanford University, I received a prestigious Eastman Kodak fellowship from Kodak. Between 1992 and 1994, I performed research on high-performance highly scaling field effect transistors in a collaborative effort with IBM. From 1994 to 1998, I performed research in high-performance thin film transistors for high-performance 3D integrated logic, memory, and display applications.

6. Between 1998 and 2000, I served as a Consulting Assistant Professor in the Electrical Engineering Department of Stanford University, and as a Visiting Research Engineer in the Department of Electrical Engineering and Computer Sciences at the University of California, Berkeley, where my research focused on 25nm MOSFET technologies for giga-scale integration. In this role, I worked on technologies for high-performance transistor processes, and published several papers as a direct outcome of this technology development.

7. In 1998, I co-founded Matrix Semiconductor, Inc., a company that pioneered the design and development of three-dimensional (3-D) integrated circuits for use in high density nonvolatile memory products. A significant focus of my activities was on the development of process technology for manufacturing these novel memory systems. I both worked on and directly managed engineers and technicians working on developing these processes. Several patents resulted from this work. Following initial volume production deliveries in 2004, Matrix Semiconductor was acquired by SanDisk Corporation and its memory products were put into high volume production. Matrix Semiconductor was nominated to the 2002 Scientific American SA50 list for visionary technology, became a Finalist for the 2003 World Technology Award for Information Technology Hardware, and won the 2005 EDN Innovation Award.

8. Although my involvement with Matrix Semiconductor ended upon its acquisition by SanDisk, I remain involved in the application of pioneering technology through other start-up companies. I served as a Founding Scientific Advisor for Kovio, Inc., a start-up company focused on semiconductor manufacturing technology based on nano-particle inks and proprietary printing methods for large area electronics, which was subsequently acquired by Thin Film Electronics. In this role, I specifically worked on packaging issues relevant to semiconductor integrated circuits. In addition, I served as the Chief Scientific

Advisor to QuSwami, Inc., a start-up company focusing on novel energy conversion devices, through 2011. Most recently, I serve as a co-founder of Dragonfly Technology, Inc., a venture-funded startup company working on "Internet of Things" Devices.

9. In July of 2000, I became an assistant professor in the University of California, Berkeley's Department of Electrical Engineering & Computer Sciences. In 2005, I was promoted to the position of tenured Associate Professor of Electrical Engineering & Computer Sciences at the University of California, Berkeley, and, in July of 2011, I was promoted to my current position of full Professor of Electrical Engineering and Computer Sciences. My current research interests include advanced CMOS devices and technology and thin film technologies for displays and integration applications, with a substantial focus on low-cost electronics for display, low-cost logic, and sensing applications. I also maintain a substantial research effort in advanced memory technology and have a large research program focused on semiconductor packaging, including specific efforts focused on development of interconnection strategies for packaging. I am also responsible for all the semiconductor device and technology courses offered within the department; I teach these courses routinely, including both undergraduate and graduate courses.

10. My service on various electrical engineering industry groups over the years includes the following:

- serving on the International Electron Device Meeting (IEDM)'s Technical Program Committee (2001-2002) and Executive Committee (2003 to 2009);
- serving on the Technical Program Committee for the Device Research Conference (2000-2002);
- serving on the Technical Program Committee for the VLSI-TSA Conference (2005);
- serving as a reviewer for the peer-reviewed publication IEEE Electron Device Letters;
- serving as a reviewer for the peer-reviewed publication IEEE Transactions on Electron Devices;
- serving as a proposal reviewer/panelist for the National Science Foundation;
- serving as a proposal reviewer for the American Chemical Society;
- being a member of the Institute of Electrical and Electronic Engineers (IEEE);
- being a member of the IEEE Electron Devices Society Organic Electronics Committee (2003 to 2007); and

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