MONDAY, JULY 16, 2012
MIAMI, FLORIDA

IEEE

I invite you to attend the 2012 Nuclear and Space Radiation Effects Conference Short Course. An outstanding group of experts will describe issues related to radiation effects in advanced electronics, particularly characterization and simulation techniques.

Ron Schrimpf,
Vanderbilt University
Short Course Chairman

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Testing and Simulation Methods for Characterizing Radiation Effects in Advanced Electronics

Announcement for the 2012 IEEE NSREC Short Course

COURSE DESCRIPTION

A one-day Short Course "Testing and Simulation Methods for Characterizing Radiation Effects in Advanced Electronics" will be presented at the 2012 IEEE Nuclear and Space Radiation Effects Conference (NSREC). This short course will provide an introduction to space radiation environments and their effects on devices and systems for those new to the field, as well as introducing advanced concepts and emerging issues for those experienced in the field. The 2012 Short Course will cover topics ranging from the interaction of radiation with electronic materials, to device response, to effects on system reliability.

The Short Course is organized into four sessions, with the first session emphasizing practical issues related to evaluation of microelectronics for use in radiation environments. This session will include the basics of radiation environments and effects, as well as application to advanced technologies. The second session focuses on methods for predicting single-event and soft-error rates, while the third session focuses on single-event effects at the system level. The final session covers radiation effects in emerging technologies, ranging from sub 22-nm CMOS to finFETs and alternate-channel devices. The presenters for the 2012 Short Course are all well-known experts in their respective areas. They will cover the background needed for newcomers to the radiation-effects field, as well as addressing current topics and advanced technologies.

The course is intended for designers, radiation effects engineers, component specialists, and other technical and management personnel who are involved in developing reliable systems designed to operate in radiation environments. This course provides a unique opportunity for NSREC attendees to benefit from the expertise of the instructors, as well as the in-depth coverage and application-oriented perspective provided by the short course format. In-depth notes will be provided at registration.

For those interested in Continuing Education Units (CEUs), there will be an open-book test at the end of the course. The course is valued at 0.6 CEUs and is endorsed by the IEEE and the International Association for Continuing Education and Training (IACET).

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PART 1 — SINGLE-EVENT AND TOTAL DOSE TESTING FOR ADVANCED ELECTRONICS

Jonathan Pellish, NASA Goddard Space Flight Center, will give a presentation that provides practical advice on end-to-end evaluation of advanced microelectronics. The term "advanced" means the electronic devices in question improve the tradespace of size, weight, and power. The presentation will be broken down into the following sections: 1) overview of the different space radiation environments common to a broad range of mission designs and perspectives on deriving meaningful requirements used in electronic component evaluation; 2) definitions and impacts of effects due to impinging particles in the space environment – e.g., total ionizing dose (TID) and single-event effects (SEE); 3) testing for and evaluation of parametric degradation in advanced microelectronics; and 4) testing for and evaluation of SEE in advanced microelectronics. The latter two topics will include content aimed at helping engineers estimate survival probabilities and on-orbit event rates utilizing available historical data, as well as considerations for ground-based accelerated testing.

PART 2 — SINGLE-EVENT EFFECT AND SOFT-ERROR RATE PREDICTION

Kevin Warren, Vanderbilt University Institute for Space and Defense Electronics, will provide an introduction to Monte-Carlo methods and simulation of single-event effects with a tie-in to the classical analytic methods. Application of physics-based transport to the problem of simulating SEU in particle radiation environments will be discussed. Specific examples for sequential logic elements will be presented. The course will begin by discussing soft error rate prediction methods, including difficulties and limitations associated with modern technologies. A physics-based Monte-Carlo rate-prediction method will be presented, including how to interpret simulator output, particle-specific simulations, simulation pitfalls, and alternatives to sensitive volumes and basic dosimetric methods. The course will close with case studies, emphasizing calibration and validation.

PART 3 — SYSTEM-LEVEL SINGLE-EVENT EFFECTS

Subhasish Mitra, Stanford University, Department of Electrical Engineering and Department of Computer Science, will provide an introduction to the design of globally-optimized robust systems with built-in protection from Single Event Single Upsets (i.e., single errors) and Single Event Multiple Upsets (SEMUs). This is possible through an inter-disciplinary approach that uniquely combines semiconductor device physics, circuit and logic design, system-level design, coding theory, and formal methods. The course will begin by discussing design techniques for soft error resilience at various layers of abstraction (circuit-level, logic-level, architecture techniques, and software techniques). Quantification of the system-level impact of soft errors will be discussed, including error injection techniques. Finally, new methods of achieving globally optimized resilience across multiple abstraction layers for maximized protection at minimized cost (expressed in terms of power, performance, area, and design complexity) will be presented.

PART 4 — RADIATION EFFECTS IN EMERGING TECHNOLOGIES

Steven Koester, University of Minnesota, Department of Electrical and Computer Engineering, will provide an introduction to radiation effects in emerging semiconductor device technologies. The course will begin with an introduction to radiation effects in silicon-based sub-22-nm node device architectures, including fully-depleted SOI, finFETs, tri-gate and nanowire devices. Both total-dose and single-event behavior will be reviewed as part of this discussion. The effect of radiation on devices with high-κ dielectrics and metal gates will also be reviewed. Next, an overview of the effect of alternative channel materials such as SiGe, Ge and compound semiconductor on radiation response will be provided. Finally, the course will close with a discussion of radiation effects in emerging materials for transistor applications, such as carbon nanotubes, graphene, and organic semiconductors.