DRC Short Course - Best Practices for Reporting on Electronic Devices – Sunday, June 21, 2026

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"Reliability Issues in Devices Based on Emerging Materials"

Prof. Tibor Grasser is an IEEE Fellow and head of the Institute for Microelectronics at TU Wien. He has edited various books, e.g. on the bias temperature instability, hot carrier degradation, and low-frequency noise (all with Springer), is a distinguished lecturer of the IEEE EDS, has been involved in outstanding conferences such as IEDM (General Chair 2021), IRPS, SISPAD, ESSERC (currently Steering Committee Chair), and IIRW, is a recipient of the Best and Outstanding Paper Awards at IRPS (2008, 2010, 2012, and 2014), IPFA (2013 and 2014), ESREF (2008) and the IEEE EDS Paul Rappaport Award (2011). He served as an Associate Editor for IEEE T-ED and Microelectronics Reliability (Elsevier).

Abstract:

Emerging transistor technologies based on novel channel and dielectric materials have been considerably improved over the past decade, but insufficient stability and long-term reliability remain major barriers to industrial adoption. This short course presents a defect-centric framework for understanding the microscopic origins of the principal instabilities observed in emerging field-effect transistors, including low-frequency noise and random telegraph noise, transfer-curve hysteresis, bias-temperature instability, hot-carrier degradation, and dielectric breakdown. Rather than treating these phenomena as separate reliability issues, the course shows how many of them can be traced to a limited set of defect-mediated processes, notably charge trapping and detrapping, migration of mobile ionic species, activation of precursor states, and bond-breaking reactions under electrical and thermal stress. Particular emphasis is placed on how defect energetics, spatial distribution, and broad time-constant spectra shape the measured response of devices under different biasing conditions, and on why similar underlying physics appears across a wide range of material platforms, including 2D semiconductors, carbon nanotubes, oxide semiconductors, organics, and related systems. By connecting measurement observables to microscopic mechanisms, the course provides a unified perspective on reliability physics and highlights open questions that still limit predictive modeling and technology qualification. The central message is that reliability must be incorporated early into material selection, process development, and device design if emerging transistors are to move from promising prototypes to manufacturable electronic technologies.