

New Methodologies for Reliability Testing and Analysis: GaN Electronic Devices - Beyond Arrhenius

Martin Kuball, Center for Device Thermography and Reliability (CDTR), University of Bristol, United Kingdom

GaN electronic devices have developed strongly within the last decade, with system integration already starting to happening at present and even more strongly anticipated in the very near future. While device performance is already outstanding both in frequency and power, there are, however, still challenges in terms of device reliability. Degradation mechanisms in this device system are still not well known, and the "unusualness" of GaN often requires the development of new methodology approaches, for reliability testing and for gaining understanding of device degradation and device failure. To complicate matters (on top of the typically high dislocation density in the GaN material), GaN is strongly piezoelectric. This effectively couples thermal and voltage effects on device degradation, i.e., they are no longer statistically independent raising also the question on how current and future reliability testing should be performed. In this tutorial I will review the current status of GaN electronics reliability, with the main focus on reviewing new methodologies developed in the context of understanding degradation and failure mechanisms of these novel devices. As most of the new methodologies developed for GaN devices are generic, outcomes from the GaN research could have benefits also for other material systems, even such as Si. Some of results shown are part of the Office of Naval Research (ONR) funded "Design for Reliability Initiative for Future Technologies" (DRIFT) program.

Author Biography

Martin Kuball is Professor at the University of Bristol, United Kingdom, where he is leading the Center for Device Thermography and Reliability (CDTR). He has a PhD from the Max Planck Institute for Solid State Physics (Stuttgart, Germany). He joined the faculty of the University of Bristol in 1997, after a two year research stay at Brown University, USA. The research of the CDTR is supported by DARPA, ONR (US), EPSRC, MOD (UK), EDA, FP7 (Europe) and various US, European and Japanese companies.