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# Spectroscopy of Single Defects in Semiconductor Transistors

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## Abstract

Modern transistors fabricated employing silicon wafers have been scaled down to dimensions in the nanometer regime. Despite the advantage of an increased switching rate and a larger number of devices per unit area, severe reliability issues have to be tackled in these devices.

The most prominent reliability issue which degrades the device performance is known as the bias temperature instability (BTI). BTI manifests itself as a threshold voltage drift and its characterization and modeling has received much attention during the last decades. However, mostly large area devices have been investigated with the drawback that only the average response of many defects can be studied. Conversely, by probing nanoscale transistors, *single charge transition events of individual traps* can be assessed. This enables a microscopic zoom mechanism and allows a detailed study of the charge trapping kinetics and physics of single defects. To probe single defects at a great level of detail the time-dependent defect spectroscopy (TDDS) has been proposed. In order to model the charge trapping kinetics, an advanced defect model has been developed in our group around the non-radiative multiphonon (NMP) theory. This talk provides a detailed insight into the requirements, the benefits and the challenges of the single defect spectroscopy. Finally, an overview of how to explain the measurement results will be presented.

## Biography

Michael Waltl received the PhD degree in electrical engineering from the TU Wien, Austria, where he is employed as Senior Scientist. Currently, Dr. Waltl is the director of the *Christian Doppler Laboratory for Single-Defect Spectroscopy in Semiconductor Devices* and heads the device characterization laboratory, both at the Institute for Microelectronics. His scientific focus is put on experimental characterization and modeling of performance degradation issues prevalent in semiconductor transistors. He received the best paper awards at IRPS 2014 and ICPTDC 2019, has been involved in the technical committee of the ESREF 2014 and IIRW 2019, and authored and co-authored over 20 peer-reviewed scientific journal publications, and more than 30 conference contributions.

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