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# Structural characterization of thin film chalcogenide glasses used in Ovonic Threshold Switches

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## Abstract

Chalcogenide materials exhibit a unique portfolio of properties which has led to their wide use for non-volatile memory applications such as optical data storage or more recently Phase-Change Random Access Memory. Chalcogenide glasses (CGs) exhibit a high transparency window in the IR range and large optical nonlinearities offering unique opportunities for elaboration of innovative mid-IR components. Besides, a huge nonlinear behavior of conductivity is observed in some CGs under electrical field application. Such CGs, mainly Se-based, are considered as promising materials to be used as Ovonic Threshold Switching (OTS) selector elements in 3D resistive memory arrays. The OTS mechanism consists in a switch between a high resistive (OFF state) and a low resistive state (ON state) when the voltage applied on the CG exceeds a critical voltage. When the current is reduced below the holding current density  $J_h$  the selector recovers its high resistive state. However, the underlying physical mechanism is still under debate with, up to now, two main classes of models involving a pure electronic effects or invoking a local structural change under field application. In that context, we investigated the origin of the OTS effect by means of a structural analysis of some prototypical and state-of-the-art  $GexSbySe(1-x)$ -based OTS glasses. The structure of selected thin films, differing significantly by the amplitude of the OTS effect and the performance of OTS devices, has been studied by means of Fourier Transform Infrared (FTIR) and Raman spectroscopy as well as X-Ray Absorption Spectroscopy. As a result, we elucidate how Sb and N doping change the structure of  $Ge_{30}Se_{70}$  glass leading to improved OTS selector performance. Finally, from such a careful structural analysis of our prototypical OTS CGs compounds coupled with ab initio simulations, one will investigate the origin of the OTS mechanism in such state-of-the-art CGs.

**Keywords:** Chalcogenide Glasses, Nonvolatile Memories, Ovonic Threshold Switching

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