# Local vibrational and mechanical characterization of Ag conducting chalcogenide glasses

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**Abstract**

Chalcogenide glasses exhibit remarkable properties, which could be used in the development of electrical memory susceptible to replace the current flash memories. During the last decades, a strong interest has been focused on superionic Ag-Ge-Se glasses for their high ionic conductivity, a property that could be used to develop ionic Conductive-Bridging Random Access Memories (CB-RAM).

Bulk Ag-Ge-Se glasses have already been widely studied for their electrical, structural and thermal properties. In particular it was shown that the conductivity of phase separated Ag$x$(Ge0.25Se0.75)100-$x$ glasses increases suddenly by seven to eight orders of magnitude at 7-10 at.%Ag. The percolation of the Ag-rich phase was at the origin of this sudden jump in conductivity.

Despite a convergence on the inhomogeneous nature of these glasses, some questions remain open such as the composition of the Ag-rich and Ag-poor phases, size and shape of the different phases. These questions has hardly been treated in literature to date.

In this talk, investigations on bulk Ag$x$(Ge0.25Se0.75)100-$x$ glasses will be performed focusing on the inhomogeneous nature of the glasses. Macroscopic and local studies of vibrational and mechanical properties will conduct using Raman (mapping) spectroscopy, Vickers microhardness and Contact Resonance Atomic Force Microscopy (CR-AFM). For the glass containing 10 at. % in Ag, Raman mapping will give evidence of a phase separation for through continuous interpenetrating phases in the spinodal decomposition process. Combined mechanical characterizations will indicate that the microhardness and rigidity modulus decrease with the silver content in the glass. At nanoscale level, CR-AFM measurements will highlight a modulation of the rigidity with Ag content. The structural origin of these

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changes will be confirmed using Raman mapping evidencing modifications in the tetrahedral network between two phases. The results could suggest a different Ge/Se ratio in Ag-poor and Ag-rich phases.

**Keywords:** Chalcogenide glasses, Raman mapping, mechanical properties, Contact Resonance Atomic Force Microscopy