Strain rate sensitivity of germanium-selenium glasses

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Abstract

Chalcogenide glasses are widely used in optical applications either as information carrier or as
sensors due to their optical transparency in the mid-infrared window (8-15 μm), high refractive index and non linearity. Glasses from the GexSe1-x system have been extensively studied over the last decades because some of their physical properties do show an anomalous behaviour (Tg, density, band gap, indentation fracture
toughness) at certain specific compositions for instance at x=20% also called the percolation threshold. In this work we studied the indentation behaviour of GexSe(1-x) ($0 \leq x \leq 30$) under constant strain rate conditions. Instrumented Berkovich micro indentation were performed at
different strain rates (from 10 -3 to 10 -1 s -1) at ambiante temperature, indentation residual imprints
were image by atomic force microscopy. Energies at stake during indentation, strain rate sensitivity
(computed from Norton's law) as well as indentation imprints shape and volumes are discussed as a
function of the litterature and glass structure. Experimental results are in good agreement with a
similar study based on pure Se glass. From AFM pictures a transition behaviour is identified near
the percolation threshold.

Keywords: Indentation, chalcogenide, strain rate, berkovich, atomic force microscopy, glass

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