Thermal, mechanical and structural properties of tellurite glasses

N.S. Tagiara[1], E. Moayedi[2], A. Kyritsis[3], L. Wondraczek[2], and E.I. Kamitsos[1,*]

[1]Theoretical and Physical Chemistry Institute,
National Hellenic Research Foundation, 116 35 Athens, Greece
[2]Otto Schott Institute of Materials Research, University of Jena, 07743 Jena, Germany
[3]National Technical University of Athens, Zografou Campus, 157 80 Athens, Greece

We present a study of glasses in the systems ZnO-TeO_2 (including pure TeO_2 glass) and $R_{2/3}O$-ZnO-TeO_2 (R=B, Al) where ZnO is replaced by B_2O_3 or Al_2O_3. Glasses were prepared by quenching the melts from Pt crucibles, and their glass transition temperature T_g, density, mechanical properties and Raman/infrared spectra were measured to correlate glass properties with structure as a function of composition. TeO_2 and ZnO-TeO_2 glasses prepared by melting in Pt crucibles were found to exhibit profound differences in terms of properties and structure when compared to similar glasses melted in alumina crucibles, a method used frequently in the literature. The origin of such differences was traced to doping of the tellurite matrix with Al_2O_3 leached from the alumina crucible. Raman spectroscopy reveals cross-linking of the tellurite network by Te-O-Al bridges, resulting in the increase of T_g (by as much as 75 ^oC for TeO_2 glass), the decrease of density and the strengthening of mechanical properties. Replacement of ZnO by Al_2O_3 or B_2O_3 leads to strongly- and weakly-interacting tellurite-aluminate and tellurite-borate structures, respectively. The findings of this study are discussed in relation to the strengths of Te-O, Al-O, B-O and Zn-O bonds.

We acknowledge support of this work by the project “Advanced Materials and Devices” (MIS 5002409), implemented under the “Action for the Strategic Development on the Research and Technological Sector”, funded by the Operational Programme "Competitiveness, Entrepreneurship and Innovation" (NSRF 2014-2020) and co-financed by Greece and the European Union.