Composition effect of Na-aluminosilicate glasses on its mechanical properties

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Plastic deformation of silicate glasses observed at glass surface is of strong interest today. In particular, we are looking for a composition impact on the deformation under indentation: densification in pure silica glass and shear bands in a float window glass. It was supposed that glass network depolymerization is the key answer in such a difference [1]. For a silica glass, the constitutive law had been developed [2] and the results of FEM simulations are in agreement with experimental Raman densification map [3].

In the present study, we work on a model system of Na-aluminosilicate (NAS) glasses with Na/Al ratio variation leading to controlled polymerization degree: 75% mol. of SiO_2, 23-13% mol. of Na_2O and 2-13% mol. of Al_2O_3. We study the detailed composition spectrum using glass diffusion approach. This technique allows us to follow precisely glass chemical composition by microprobe analysis, its structure by Raman spectroscopy and its mechanical properties (Young modulus and hardness) by nano-indentation. We show in this system the difference in Young moduli and hardness evolutions. The link to glass structure is followed. Glass polymerization being a major factor seems to be not the only reason in contrasted Young modulus evolution in our NAS glasses model system.

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