DSCM 52P **FRACTURE TOUGHNESS AND HARDNESS AT MICRO- AND NANOINDENTATION OF PHOSPHATE GLASSES DEPENDING ON THEIR COMPOSITION**

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Phosphate glasses are promising candidates for fast ion conductors, waveguides, optical switches, fibers, etc. However their applications are often hindered by their low chemical durability, therefore the seeking of new improved composition is a key point. At the same time, the new composition should not affect the mechanical durability, which along with chemical stability, optical and magneto-optical properties of phosphate glasses, is an important issue for a reliable and durable function of the systems and devices on their base.

Two groups of glasses of a basic aluminophosphate (Al_2O_3–P_2O_5–Li_2O–BaO–La_2O_3) composition (APG) doped with Dy_2O_3, Tb_2O_3 and Fe_2O_3, and borophosphate (B_2O_3–P_2O_5–Li_2O–Al_2O_3–ZnO) composition (BPG) codoped with Dy_2O_3–Tb_2O_3, Bi_2O_3–PbO and CoO were investigated for hardness (H), Young's modulus (E) and fracture toughness (K_{IC}) and the comparative analysis was carried out. The dynamic nanoindentation and quasistatic microindentation technique within the load range of 0.02–2.0 N were used in this study.

As a whole, BPGs show improved mechanical properties in comparison with APGs. This is manifested by higher values of H, E and K_{IC} for undoped glass (Fig. 1, a, b, c). The smaller ionic radius of B^{3+} and Zn^{2+} in BPG in comparison with those ones of Ba^{2+} and La^{3+} in APG is expected to strengthen the glass structure, which explains higher values of H and E. It is important that increase of H does not affect the values of K_{IC}, which has usually a decreasing tendency for harder materials. The addition of dopants for optical and magneto-optical properties induces some changes in the values of H, E and K_{IC} (Fig. 1, a, b, c). It is suggested that these changes may be connected with ionic radius and concentration of dopants. Indentation size effect, manifested by decrease of hardness with load increase, observed for all investigated glasses, was explained by the decreasing contribution of permanent densification, intensification of plastic flow and crack initiation (Fig. 1, d, e) resulting in the relaxation of internal stresses and softening of material.

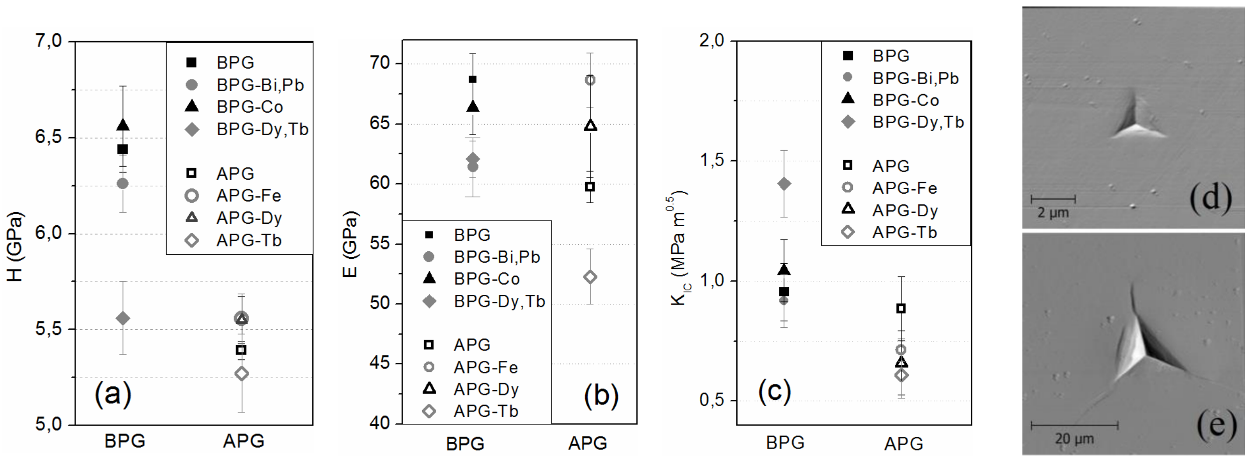

Fig. 2. Comparative analysis of the values of: (a) hardness (H), (b) Young's modulus (E) and (c) fracture toughness (K_{IC}) for glasses of different composition measured at 500 mN (a-b) and 2.0 N (c). AFM images of indentations made with load of 20 mN (d) and 900 mN (e).