## *DSCM 58P* PROLONGED HOLDING AND CYCLIC LOADING INDENTATION OF ALUMINOPHOSPHATE GLASS: KINETICS OF DEFORMATION

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The time-dependent mechanical behavior of aluminophosphate glasses (APG) ($Li_2O$–$Al_2O_3$–BaO–$La_2O_3$–$P_2O_5$–$RE_2O_3$, RE = Dy, Tb) subjected to dynamic indentation under prolonged holding and cyclic loading conditions in combination with different loading rates is presented in this work. Analysis of the load-displacement (*P-h*) and displacement-time (*h-t*) dependences was applied to investigate the deformation peculiarities and kinetics of deformation in these conditions.

The 300 s holding under the maximum load during indentation shows a creep of material (continued deformation under constant peak load, $P_{max}$) (Fig. 1, a), which appears to be dependent on the loading rate and namely, the higher the loading rate, the larger the total displacement during creep (Fig. 1, b). For both types of indentation made with high and low loading rates, the creep rate (*dh/dt*) has a decelerating character at the beginning of the creep portion setting to a constant value after 50-100 s and this value is higher for higher loading rate indentation (20 mN/s). The application of different loading rate may cause the modification of the relative contribution of certain deformation mechanisms specific to phosphate glasses, such as, permanent densification, plastic flow and fracture [1], which in turn can cause different deformation behavior.

The applied cyclic indentation, prolonged holding indentation (Fig. 1, a) and a combination of them (Fig. 1, c) represents in fact a modeling of wear and fatigue processes. The using of these loading conditions leads to the decrease of hardness values in comparison with those obtained under standard indentation conditions with short holding time (5 s) and one loading-unloading cycle. The cyclic indentation combined with holding showed the maximum hardness decrease of 32% and 17% for APG-Dy and APG-Tb, respectively, for loading rate of 2 mN/s. For 20 mN/s rate these values are somewhat smaller, 22 and 14%, respectively. The cyclic indentation induces the smallest decrease of hardness and the indentation with prolonged holding has intermediate position. This tendency is maintained for both glasses and both loading rates used. These results suggest about the time dependence of the deformation processes in APG resulting in a loss of material strength.

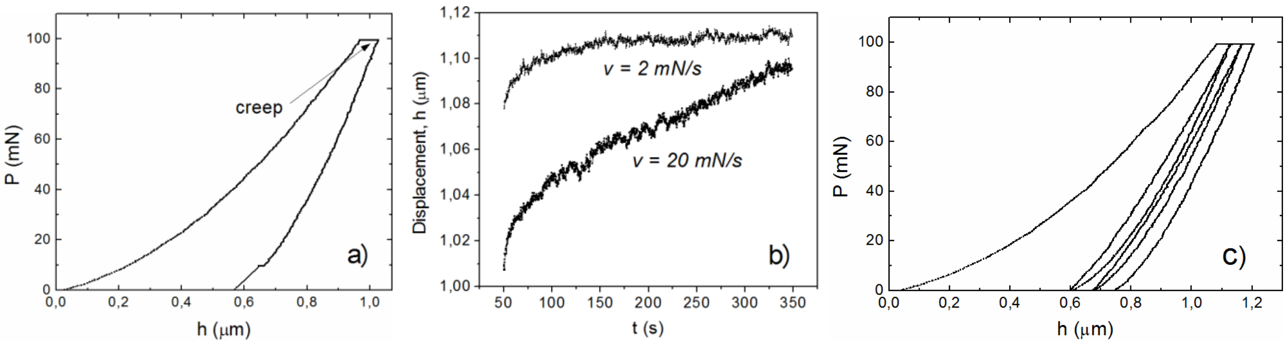


*Fig. 1. (a) P-h curve for 100 mN indentation made with 300 s holding under peak load, $P_{max}$; (b) h-t dependence for "creep" portion for indentations made with different loading rate; (c) P-h curve for cyclic loading with 100 s holding at $P_{max}$ within each cycle.*

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