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Surface engineering of soda lime silicate glass under thermal poling process for hardness reinforcement

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Surface engineering of soda-lime silicate glass has been performed by thermal poling and the correlation between the modification of the glass composition, the local structure and the mechanical properties of the field-induced modified surface has been investigated. Glow discharge optical emission spectroscopy (GD-OES) demonstrates the multi-layered structuring of the glass surface, due to the migration of mobile cations species. The nature of the atmosphere during poling directly impacts on the charge compensation mechanisms, the multi-layer shape and composition. This work demonstrates the presence of a pure layer of silica beneath the surface of the poled glass under N₂ which strongly increases the mechanical properties of soda-lime glass, especially hardness. The thermal poling treatment is then used to enhance a densification of the poled region and a compressive stress at the silica nanometric layer surface.

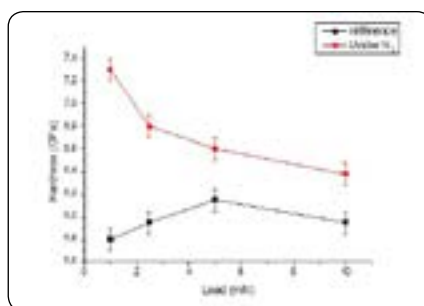


Figure 1: Berkovitch nano-indentation results on unpoled reference versus poled soda-lime glass under N₂.

Recent Publications

1. Jiang L et al. (2013) Different K⁺-Na⁺ inter-diffusion kinetics between the air side and tin side of an ion-exchanged float aluminosilicate glass. *Applied Surface Science* 265:889-894.
2. Lepienski C M, Giacometti J A, et al. (1993) Electric field distribution and near-surface modifications in soda-lime glass submitted to a dc potential. *Journal of Non-Crystalline Solids* 159:204-212.
3. Krieger U and Lanford W A (1988) Field assisted transport of Na⁺ ions, Ca²⁺ ions and electrons in commercial soda-lime glass I: Experimental. *Journal of Non-Crystalline Solids* 102:50-61.
4. Carlson D E, Hang K W and Stockdale G F (1974) Ion depletion of glass at a blocking anode: II, properties of ion-depleted glasses. *Journal of American Ceramic Society* 57(7):295-300.
5. Dussauze M, Rodriguez V, et al. (2010) How does thermal poling affect the structure of soda-lime glass. *Journal of Physical Chemistry C* 114:12754-12759.

Biography

Fargin Evelyne has strong experience in nonlinear optical properties of glasses and particularly third and second order nonlinear susceptibility. She implanted in Bordeaux the surface glass processing by poling which is now developed with co-workers for composition, mechanical properties and optical structuring of the glass surface. She recently developed new heavy glass oxides for fiber applications thanks to strong collaborations inside an international laboratory LUMAQ (U. Bordeaux, COPL Laval, INRS Québec). She also was involved in the study and optimization of laser-induced defects in glasses and luminescence properties of flaws for the Megajoule Laser Facility in Bordeaux.

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