Stress and local structure evolution in the sol-gel thin-films during high temperature annealing

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Abstract

To provide thermal comfort and reduce carbon footprint, many functions are provided to glazing by coating, for applications related to buildings, transport or decoration. In some cases, these glass products must undergo thermal tempering to give the glass better mechanical strength. The development of functional coatings resistant to high temperatures ($> 600\circ$C) is thus a major challenge that sol-gel coatings can contribute to address. Indeed, the inorganic nature of the precursors is compatible with temperature resistance and allows good covalent adhesion to glass substrate. However, one of the limitations of these materials is the cracks generated in the layers due to the high tensile stresses that occurs during the condensation of the network and the evaporation of solvents. In addition, two known phenomena occur during tempering: the diffusion of alkali ions from the substrate to the layer and the passage of the melting temperature of the glass, which complicates the mechanics of the problem. This leads to a serious limitation in the achievable thicknesses of coatings and reduces the field of possible applications for the design of new products. The objective of this work is to better understand the relationships between the glass substrate, the structure, and the mechanical properties of the silica-based sol-gel layers during this complex tempering process. This poster will focus on the methodologies developed to establish the link between the evolution of the microstructure of the layer, the apparition of stress during the tempering coupled with the mechanical properties' evolution. Particular attention will be paid to the mechanical measurements based on nanoindentation in temperature (in-situ), separation of substrate and coating response from nanoindentation and cracks observation.

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