Kinetics of phase separation in barium borosilicate glass thin films deposited by magnetron sputtering

Barbara Bouteille*[1,2]

[1]Surface du Verre et Interfaces (SVI) – Université Pierre et Marie Curie - Paris 6, SAINT-GOBAIN, Centre National de la Recherche Scientifique : UMR125 – SVI UMR 125 CNRS/Saint-Gobain Recherche 39 quai Lucien Lefranc - BP 135 F 93303 Aubervilliers Cedex, France

[2]Physique et mécanique des milieux hétérogenes (PMMH) – Université Pierre et Marie Curie - Paris 6, Université Paris Diderot - Paris 7, ESPCI ParisTech, Centre National de la Recherche Scientifique : UMR7636 – 10 Rue Vauquelin 75231 PARIS CEDEX 05, France

Abstract

Liquid/liquid phase separation has already been studied in bulk glasses where the morphological evolution and the growth of phase domains during the coarsening stage are of particular interest. It is known that growth law highly depends on the morphology of domains. When droplets are formed, their growth is limited by diffusion and their size scales with time to the third. On the contrary, the coarsening of interconnected domains is controlled by hydrodynamic transport mechanisms and characteristic size scales linearly with time.

In this study we investigate phase separation in glass thin films in order to use this phenomenon as a glass surface nano-structuring method. From a process point of view, industrial glass surfaces are often functionalized by magnetron sputtering. Metallic and dielectric thin films are deposited in order to add new optical, morphological or mechanical properties. In order to understand kinetics and mechanisms of phase separation, thin layers of barium borosilicate glass are deposited by magnetron sputtering with thickness range between 20 and 200 nm. They were studied after annealing at high temperature, from 700∘C to 1000∘C. Kinetics has been determined by several techniques such as AFM, postmortem SEM and in-situ SEM. Thanks to Python image processing, statistical data showed a good agreement between these techniques. Growth kinetics in barium borosilicate glass thin films are found significantly slower compared to the bulk.

As in bulk glasses, composition, temperature and annealing time impact the final morphology of phase separation. Besides we have observed that droplets growth is also influenced by additionnal parameters such as glass layer thickness and the nature of substrate. All these parameters allow to control morphologies and size of objects obtained by phase separation.

Keywords: Phase separation, glass thin film, barium borosilicate, nanostructuration

*Speaker