DIFFUSION BETWEEN SILICA THIN FILM DEPOSITED BY REACTIVE MAGNETRON SPUTTERING AND GLASS SUBSTRATE DURING ANNEALING AT HIGH TEMPERATURE

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Industrial processes often involve annealing and/or tempering glass panels coated with thin films. Diffusion of alkali ions from the substrate to the active layers is typically observed during these treatments and can modify properties of these thin films. In order to understand the kinetics and mechanisms of this phenomenon, amorphous silica thin films (pure or doped with aluminum) deposited by magnetron sputtering under reactive atmosphere onto glass substrates have been studied after annealing above the glass transition temperature (Tg). Various techniques such as SIMS, SEM, AFM, XPS, EPMA and Raman Spectroscopy were used for the evaluation of the composition depth profile and the microstructure characterization.

Our investigations show that annealing commercial soda-lime glass substrates coated with silica thin films above Tg leads to migration phenomena between silica and glass with two essential steps:

- A fast migration of alkali ions (especially sodium and potassium) from the substrate to the film is first observed. This transport phenomenon is shown to strongly depend on aluminum doping in silica layers. In particular the alkali ions concentration obtained in the silica layer after annealing scales linearly with the initial aluminium concentration in the silica layer (**Figure 1**).
- A slow homogenization then takes place at the interface between the silica thin film and the glass substrate. This second phenomenon is controlled by the interdiffusion of the st of all elements. We observe a gradual thinning of the silica layer with the square root of time (**Figure 2**).

Differents annealing durations and temperatures were studied since these phenomena depend on elements mobility and activity. Moreover the impact of deposition conditions was also studied (like the deposition pressure) since these parameters can have an influence on the silica layer properties.

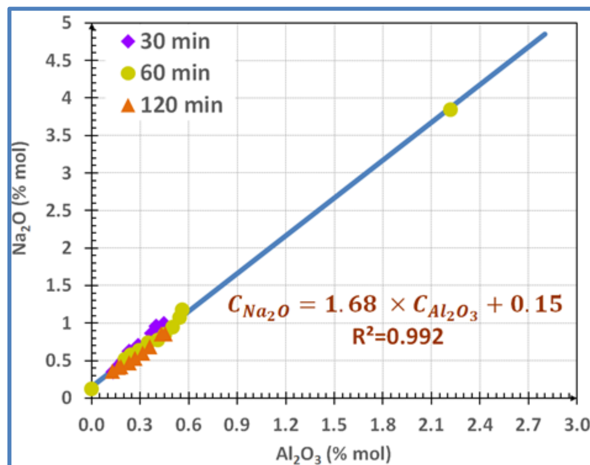

Figure 1: Na_2O concentrations in silica layers with various Al_2O_3 doping - after annealing for 30, 60 and 120 minutes at 650°C.

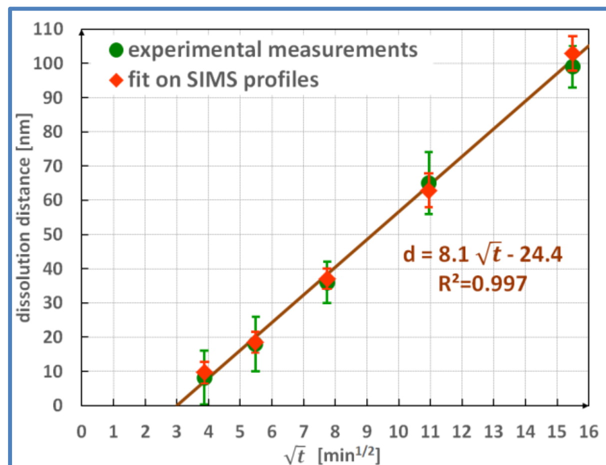

Figure 2: dissolution distance for 150nm thick silica layers for different annealing durations at 650°C.