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TELLIPSOMETRY IN TWENTE: DYNAMICS OF THIN FILM MEMBRANES UNDER APPLIED TEMPERATURE PROFILES

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We use in-situ ellipsometry to study the structural and chemical evolution of thin films as function of the temperature ('Tellipsometry'). Particular focus is on organic, inorganic, and hybrid materials that are relevant to artificial membrane fabrication and operation. Our poster shows some illustrative examples.

Inorganic and hybrid materials

The fabrication of thin inorganic and organic-inorganic hybrid thin films typically involves a temperature treatment step that dictates many of the final chemical and structural properties of the film. We present the changes density and thickness of sol-gel derived amorphous silica and organosilica films (~0.1 mu thick) upon heating to 550° C. For silica films, the shrinkage of the material closely follows the weight loss as recorded via thermogravimetric analysis. The densification behavior of organosilica layers is quite different. Where weight loss is recorded in thermogravimetric analysis, no shrinkage occurs in the thin film, implying a strong decrease in the density of the material upon heating.

Organic materials

It is well-recognized that the glass transition temperature of a polymer can be influenced by the presence of small penetrant molecules that dilate the material, thereby allowing increased macromolecular mobility. This is referred to as plasticization and is manifested by a reduction in the Tg. We quantify the depression of the transition temperature of thin films exposed to a solvent by in-situ ellipsometry, from the shift in the kink of a dilation-temperature curve. For example, for polystyrene exposed to n-octane the glass transition temperature drops from 100.0° C to 29.6° C.

Thermal exposure may also cause changes materials chemistry. As example, we show the irreversible changes in UV light absorption of a sulfonated poly-ether-ether-ketone film heated to 220° C, due to desulfonation of the material.