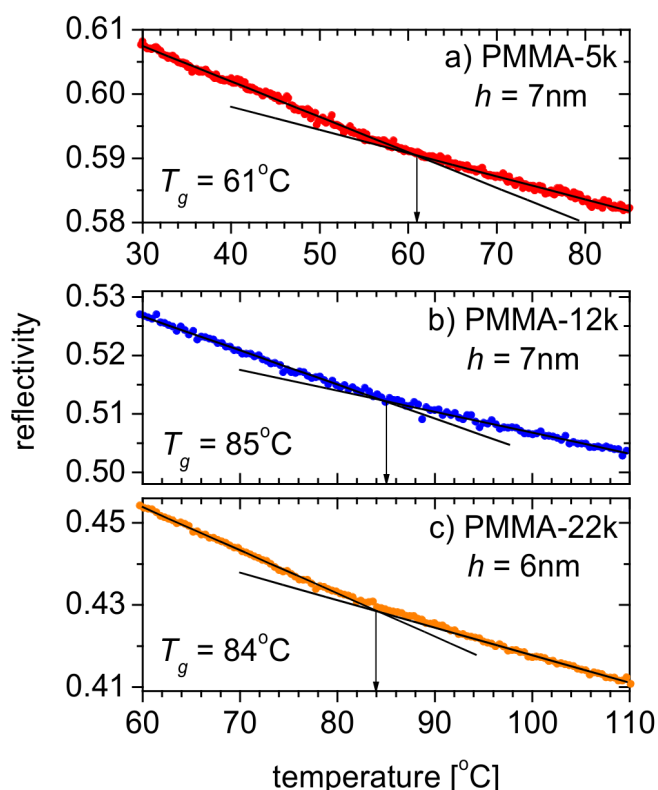


Glass transition temperature in thin polymer films

Using Surface Plasmon Spectroscopy and Optical Waveguide Spectroscopy in combination with a RES-TEC temperature controller it is possible to study thermally induced physical transitions in thin films. One example is the determination of the glass transition temperature of thin to ultrathin polymer layers.¹

Physical properties of material may change dramatically if the material is confined in the geometry of a thin or ultrathin film. In order to determine such effects it is necessary to measure them in such formats.

Here, we present data recorded from thin Polymethylmethacrylate (PMMA) films of different MW in SPR kinetic mode during heating runs using a temperature controller. The measured effect is caused by a combination of changes of the thickness and refractive index due to the thermal expansion of the film upon heating. This combined quantity changes abruptly at the glass transition temperature and causes an inflection point that separates two linear regimes. The data demonstrates that SPR can be used to determine a rather small change even in very thin films of only a few nanometers.



Kinetic scans obtained at $\Theta_M < \Theta_R$ for ultrathin films of PMMA of variable molecular weights (5,000 – 22,000 g/mol). The intersection of the linear fits indicates the glass transition temperatures of these films.

¹ O. Prucker, S. Christian, H. Bock, J. Rhe, C.W. Frank, W. Knoll, *Macromol. Chem. Phys.* **199**, 1435–1444 (1998).