

Shear thinning and frequency dependent behaviour of adsorbed polymer layers Part I. Experimental aspects and a first order analysis

ABSTRACT

Nanorheological measurements were carried out using an oscillatory AFM technique to investigate the viscoelastic properties of adsorbed hydroxypropyl guar (HPG) layers. The oscillations were performed at frequencies between 300 Hz and 1 kHz, with applied oscillation amplitudes of 2 nm. Qualitative data analysis was carried out using complex viscosity and complex modulus transfer functions based on a hydrodynamic lubrication model. The results indicated viscous behaviour at large surface separations and viscoelastic behaviour in the region of polymer layer overlap, as would be expected for adsorbed polymer layers. However, the adsorbed HPG layers also showed an indication of frequency dependent viscoelastic behaviour and shear thinning (reduction of viscosity with frequency). Furthermore, there appeared to be an unanticipated correlation between the apparent thickness of the adsorbed layers and the viscoelastic properties of the system, which may be attributed to the shear thinning behaviour of the layers.

Keyword: Hydroxypropyl guar (HPG), Atomic force microscope (AFM), Polymer-coated surface