SFM in Controlled Vapour Environment as a Tool to Observe Induced Morphology Changes of Polymer Nanostructures at Interfaces in Real Time

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Morphology conversions of adsorbed polymer nanostructures can be stimulated by an exposure to different vapours [1]. The controlled rate of such transformations is sufficiently slow to allow the real-time following by in situ scanning force microscopy (SFM). Recently we reported on reversible reorganisations of self-assembled nanostructures formed by perfluoroalkyl-alkanes in vapours of selective and nonselective solvents, as observed by SFM [2]. The same approach allowed us to visualise step-by-step coil-to-globule conformational transitions of individual adsorbed polymer chains in different vapours [3]. Here we present real-time SFM-observations of vapour-induced structural transformations of ultrathin block-copolymer films on a mica substrate. Coadsorption of small molecules from vapour phase modifies the interaction of the adsorbed polymer chains with the substrate and stimulates their reorganisation. Thus, the adsorbed polymer film is forced to minimise the occupied surface area by the coadsorbed ethanol molecules, which, being amphiphilic, are more effective in the interface energy reduction. To the contrary, the coadsorbed water film stimulates spreading of the amphiphilic polymer chains and extension of the adsorbed polymer film [4].

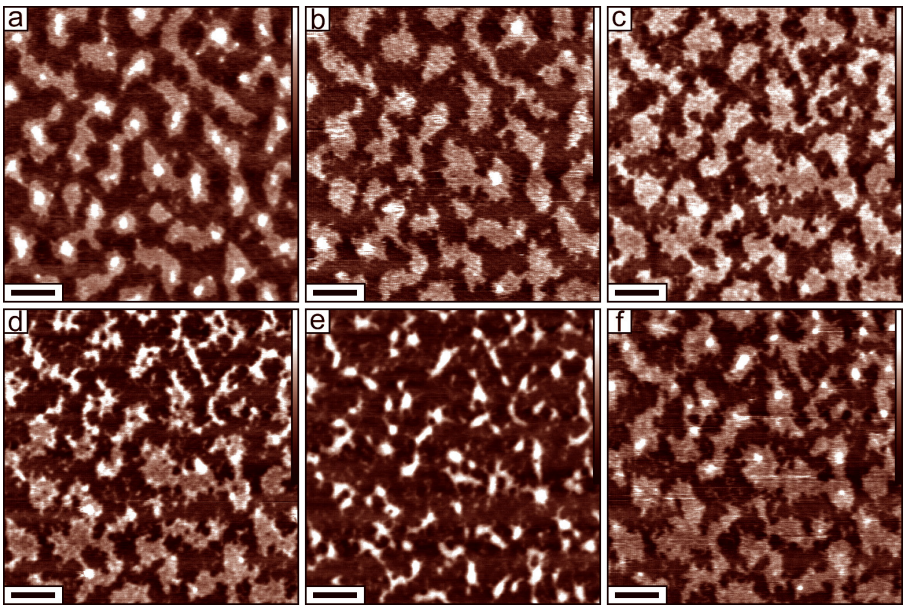

Fig. 1: Sequence of SFM micrographs demonstrating successive transformations of the ultrathin $P2VP_{960}$-*b*-PEO_{1680} film on mica in a vapour environment; a) as deposited by dip-coating; b,c) polymer spreading after 30 (b) and 45 (c) min exposure to water vapour; d,e: partial collapse after 15 (d) and 30 (e) min exposure to ethanol vapour; f: continued reextension in water vapour (30 min exposure). Bar size: 150 nm, height scales: 2-3 nm.

References:
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[2] A. Mourran, B. Tartsch, M. Gallyamov, et al., Langmuir 21 (2005), 2308.
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