

Nanocarbons-induced hardening of ultrathin polysiloxane block copolymer films

Ankudinov A.V.*^{1,2}, Voznyakovskii A.P.³, Nyapshaev I.A.¹

¹ Ioffe Institute, 194021, St.Petersburg, Russia

² National Research University ITMO, 197101, St.Petersburg, Russia

³ Scientific Research Institute for Synthetic Rubber, 198021, St.Petersburg, Russia

*e-mail: Alexander.Ankudinov@mail.ioffe.ru

Ultrathin films of polysiloxane block copolymers and their composites with modifying addition of C₆₀ were studied by atomic force microscopy (AFM). Independently on the concentration of additives, nanometre scale surface patterns were revealed in the relief of the films. These patterns were associated with the spatial distribution of rigid block domains at the block copolymer surface. Reliable quantitative data of the mechanical parameters of the films were obtained in indentation tests using specially manufactured spherical AFM probes of calibrated submicron radius of curvature. The measured parameters correlated with standard physical and mechanical testing parameters for thick films. It was found that the addition of C₆₀ at the level of 0.01% significantly improved the elasticity of the block copolymer surface layers. This concentration may introduce a few fullerene molecules into each nanodomain of rigid blocks. The results on modification of polysiloxane block copolymers by nanodiamond particles will be also considered.

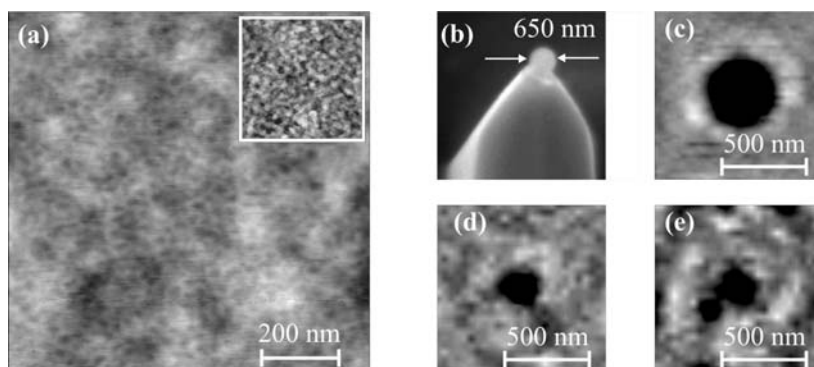


Figure.1. High resolution tapping mode AFM image of block copolymer surface topography measured with a standard sharp probe (averaged tapping force is 150 pN), (a). In the upper right corner of the image (a) a fragment of the TEM micrographs of the block copolymer is inserted. SEM image of the special AFM probe, (b). Tapping mode AFM images of the surface areas of different block copolymer films measured after indentation tests with a maximum force (strain): 265 nN (99 nm), (c); 560 nN (42 nm), (d); 570 nN (32 nm), (e). Films description: (c) block copolymer without curing agent, (d) with curing agent, (a) and (e) with curing agent and with addition of 0.01 weighting % of C₆₀. Gray scale of AFM images: (a) 2.7 nm, (c) 20 nm, (d) 9 nm, (e) 4 nm. AFM image (a) and TEM insert have the same scale bar.