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NEUTRON AND X-RAY REFLECTOMETRY STUDY OF STRUCTURE IN THIN FILMS OF POLYSTYRENE-FULLERENE NANOCOMPOSITES

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Thin polymer films have numerous technological applications in various industrial and biomedical sectors[1]. In many cases, the films can be of complex composition with different types of polymers with complex architecture and other components such as nanoparticles. Polymers in thin films and nanocomposite structures can exhibit unusual physical properties due to the geometric constraints imposed by the presence of surfaces and interfaces. Polystyrene-fullerene films present a suitable model system for investigation of these properties. Neutron and x-ay reflectometry have proved to be effective methods for studying PS/C60 thin films, allowing evaluating the structural peculiarities of nanoparticles ordering in the polymer matrix [2].
Several physically based models of structural organization of the nanoparticles in polymer matrix are considered –a uniform distribution, a dense substrate layer, a layer on the surface of a polymer. Our modeling shows that it is possible to apply neutron and x-ray reflectometry for clarifying the structural organization of nanoparticles in the nanocomposites with the mass concentration of fullerenes exceeding 1%.
In the present work, we performed study of structure in thin films of polystyrene-fullerene nanocomposites. PS/C60 and PS/C70 solutions in toluene were spin-coated on Si (111) at 2000-6000 rpm after filtering through 0.22 Milipore filter. Series of thin films samples with different concentration of fullerenes were prepared and investigated for the internal structure.
Neutron measurements of polymer thin films in the temperature range up to 130℃ were performed at the GRAINS instrument of the IBR-2, JINR. For this purpose, a special cell for samples was designed and created. Possible internal structure of films has been analyzed.
[1] E.Slaver. Polymer Thin Films, 304 (2016).
[2] Yaklin, M. a., Duxbury, P. M., & Mackay, M. E. (2008). Control of nanoparticle dispersion in thin polymer films. Soft Matter, 4(12), 2441.

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