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Structure of Polymer-nanocomposites – A USAXS Study. R. Aravinda Narayanan¹, P. Thiyagarajan¹, B.J. Ash², S.S. Sternstein², A.J. Zhu², L. Schadler², ¹Intense Pulsed Neutron Source Div., Argonne National Laboratory, Argonne, IL 60439, ²Materials Science and Engineering Dept., Rensselaer Polytechnic Institute, Troy, NY 12180.

In order to understand the molecular mechanisms responsible for the reinforcement of polymeric materials by nano-sized inorganic fillers, we have undertaken ultra small angle x-ray scattering (USAXS) measurements on silica-polyvinylacetate(PVAc) nanocomposites, in combination with studies on their mechanical behavior. Fumed silica particles of specific surface areas ranging between 100-380m²/g, which were also treated with various organic groups so as to alter the bonding between the particle and polymer matrix - PVAc of molecular weight 83K were used. USAXS results suggest that the nanoparticle surface has a fractal structure whose dimension varies depending on the surface treatment. Combining evidence from mechanical studies, we suggest a relationship between surface roughness and composite reinforcement. The nanoparticles aggregate to a average size of 250 Å which is significantly reduced in the case of surface treated fillers. It is also found that the fillers agglomerate to form a mass-fractal whose geometry varies between a disc and a rod, depending on the silica volume fraction, as seen through the volume fractal dimension.

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