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On the peculiar mechanical and tribological behavior of polymer nanocomposites with nanotubes of WS_2 and nanowires of $Mo_6S_2I_8$

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We report on the preparation and resulting mechanical and tribological properties of polymer nanocomposites (PNC) based on nanotubes of tungsten disulfide (WS_2) and nanowires of $Mo_6S_2I_8$ (MoSI) with both; a semicrystalline apolar and an amorphous polar thermoplastic polymer (i-PP, PC). The PNCs were obtained by melt-mixing of nanoparticles into polymer using a lab-scale conical twin-screw extruder. We present the results of the mechanical and tribological properties of the PNC in function of NP-concentration and processing conditions. Most, interesting is the fact that excellent reinforcement of both polymer matrices is obtained with both types of nanoparticle morphologies (wires and tubes). Up to 1.5 wt% nanoparticle concentration one observes a steady increase of Young's modulus. Higher concentrations mark a plateau, which is ca. 25% higher than the pure polymer matrix. Estimates of the fibre aspect ratio, employing the reinforcement model of Halpin and Tsai, give very high values that are apparently beyond any physical sense, marking the limits of the Halpin-Tsai model. We point out that the extremely high reinforcing effect cannot be attributed to the induction of crystallinity nor changes in the crystalline morphology, because the effect occurs in the amorphous matrix as well. Studies of the tribological properties of the i-PP composites revealed a reduction of the friction coefficient by ca. 25% at a concentration of 1.5wt%. Composites with WS_2-nanotubes performed better than nanowires of $Mo_6S_2I_8$. Likewise wear rate was reduced by ca. 25%, although here the nanowires of $Mo_6S_2I_8$ showed better results.

Biography

Johann G Meier studied Chemistry from 1991-1996 at Humboldt-University Berlin. He graduated with a Master thesis on photo-orientation of liquid crystal side chain polymer films. He then went to Chalmers University of Technology, Gothenburg, working on chiral and polar effects in liquid crystals in the group of S. T. Lagerwall, receiving his Doctorate for the discovery, characterization and description of an anti-ferroelectric twist grain boundary liquid crystalline phase in 2002. From 2002-2006, he was Post-Doc at Deutsches Institut für Kautschuktechnologie (DIK); Hanover, focusing there on reinforcement of elastomers, polymer-nanoparticle interactions and filler network structures. Since October 2006 he has been at the Instituto Tecnológico de Aragón, Zaragoza were he has built-up the research line on polymer nanocomposites. He has authored more than 30 papers.

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