Polar and apolar thermoplastic polymers nanocomposites with WS_2-nanotubes and of $Mo_6S_2I_8$-nanowires: Preparation, thermal and mechanical properties

Johann G. Meier, Mariana Castrillón García, Cristina Crespo, José Alberto Lorda

Instituto Tecnológico de Aragón, C/ María de Luna 7-8, Zaragoza, Spain
jmeier@itainnova.es

Abstract

Inorganic tubular and wire-like nanomaterials based on WS_2 and MoSI are an interesting new alternative to carbon nanotubes [1, 2]. They show advantages such as easy synthetic access, good uniformity and solubility, and predefined electrical conductivity depending on the composition of the starting material. One of the most outstanding properties of both types of nanoparticles is their low inter-particle shear modulus, while having comparable tensile moduli to CNTs. This has the advantage that they are potentially much easier to disperse than carbon nanotubes. Also common to both types of nanoparticles (metal base W and Mo) is their excellent lubrication property This makes them highly attractive as additives for friction reduction and wear protection of polymers [3]. They are therefore very promising candidates as active fillers for polymers for mechanical reinforcement, improvement of toughness, facture toughness and fatigue behavior together with improving the tribological properties of the polymer host [4]. Hence, they hold the promise to give answers to these technological paramount property in polymers.

We report on the preparation and resulting thermal and mechanical properties of polymer nanocomposites (PNC) based on nanotubes of tungsten disulfide (WS_2) and nanowires of $Mo_6S_2I_8$ (MoSI) with different polar and apolar thermoplastic polymers (i-PP, PET, PS, PC).

The PNCs were obtained by direct incorporation of the nanoparticles into the melt of the polymer using a lab-scale conical twin-screw extruder. NPs were pretreated with ultrasound in dispersion in acetone, filtered and dried before incorporation. SEM confirmed the excellent dispersion state of the nanotubes or wires in the polymer matrices. Significant improvements of the thermal stability of the PNCs of PC and PP were observed in function of nanoparticle concentration, but surprisingly not for PET nor PS., Likewise, the Young's modulus increased with NP concentration of up to 30% at 3 wt%. We will discuss the thermal and mechanical effects.

References

1. R. Tenne and G. Seifert, Ann. Rev. Mater. Res., **39** (2009) 387.
2. D. Mihailovic, Prog. Mater Sci., **54** (2009) 309.
3. J. G. Meier, A. Mrzel *et al.*, physica status solidi (a), **210** (2013) 2307.
4. M. Naffakh, A. M. Díez-Pascual *et al.*, Prog. Polym. Sci., **38** (2013) 1163.