PROPERTIES OF THERMOPLASTIC (ELASTOMER) CARBON BASED NANOCOMPOSITES

K. Schulte*, S. Buschhorn, G. Broza and L.A.S de A. Prado

Technische Universität Hamburg-Harburg
Institute of Polymers & Composites, Hamburg, Germany
schulte@tuhh.de

ABSTRACT

Due to their unique electrical, mechanical and thermal properties, carbon nanotubes (CNTs) have been receiving a great deal of attention, especially in the field of polymer nanocomposites.
Very low electrical percolation threshold values have been reported for epoxy/CNT nanocomposites. In spite of relatively high electrical conductivity of epoxy/CNTs at low filler loadings, some properties such as storage modulus and glass transition temperature are barely improved by CNTs. This behaviour is mostly observed for high performance thermosets.
On the other hand, the dispersion of carbon nanotubes or carbon nanofibres in thermoplastics can improve significantly the mechanical properties and thermo-oxidative stability of these polymers, and the crystallinity degree and electrical conductivity of the matrix

These improvements depends on several factors:

- Filler dispersion and geometry
- Interfacial adhesion
- Surface functionalisation (oxidation, presence of amine groups, acrylate polymers, etc…)
- Specific interactions between filler and matrix (hydrogen-bonds, van der Waals forces, ion-dipole forces, π-π stacking)
- Polymer composition and microstructure (e.g. polymer blend morphology, polymer polarity)
- Presence, morphology and properties of the interphase around the nanoparticles

In general, the filler/matrix interactions can contribute to the filler reinforcement effect in terms of optimized load transfer during deformation. In fact, a strong filler/matrix interaction increases the potential of reinforcement and dispersion grade. In fact, polymers having dipole-dipole, hydrogen bonding and ion-dipole forces with the carbon-based fillers could have their properties more improved than less polar polymers, such as polypropylene. This was observed for nanocomposites based on polyamide-12, polycarbonate, poly(butylene terephthalate), polyelectrolytes, to name a few.
Usually a more significant improvement of mechanical properties can be observed for softened matrices, such as thermoplastic elastomers. Even better reinforcement effects are achieved by means of filler functionalisation.
In the presentation we will discuss the improvements already achieved in carbon based nanocomposites and outline the remaining potential with better processes, tailored interfaces and improved carbon based nanoparticles as nanotubes, graphene etc.