Editorial corner – a personal view

Nanocomposites, excellent properties or hype?

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Nanotechnology, nanostructured polymers, nanoparticles and nanocomposites have been a hot research topic of high promise for years. A lot has been done, highly interesting scientific findings and even significant technical applications, yet there are still unfulfilled promises and visions to be made true.

Carbon nanotubes, nanofibrous cellulose and TiO₂-nanoparticles, just to mention a few, have numerous interesting properties that might upgrade polymer properties to a new level in composites, that at least is the high flying vision for the future.

However, some of the visions and promises seem to have been heavily hyped up. Often individual nanofibre's or particle's properties are extrapolated straight forward to the bulk material's technical properties – and the hype is ready. By using e.g. tiny amounts of CNF's on polymer matrix we are promised extraordinary mechanical stiffness and toughness, superior electrical conductivity, high heat conductivity, light weight and excellent processability. Often said prerequisites are nanoscale dispersion in a polymer matrix and good interfacial adhesion i.e. compatibility. Is this all that is needed? No, also a rather high nanoparticle concentration is often needed, to ensure percolation for electrical conductivity or entanglements for mechanical reinforcing.

In addition, the state of the art in technical composites is still far away from the fantastic visions. Carbon nanofibre concentrations of 2–3% are needed to exceed the percolation limit for electrical conductivity. The mechanical toughness increment is

around 30% by using the CNF's, a level easily achievable with conventional reinforcements. High heat conductivities by using small amounts of NFC's in composites is just a dream, at least based on our experiments.

Too often in nanocomposite articles only one mechanical parameter, modulus, is reported. This does not give a comprehensive picture of the essential properties of the materials. Actually, it is rather obvious to achieve high modulus values in blends and composites whilst effects on elongation and breaking energy are neglected. So there seems to be lacking in information and contradiction between phenomena and wishes in the field.

In spite of this criticism it is good to keep in mind that nature is a master in optimising nanostructures in materials. Also, nature has shown that significant improvements in materials properties can be reached, and tailored properties achieved. Can we, as polymer scientists, achieve something that even remotely resembles the level of control that can be found in nature's materials.

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