Multi-dimensional carbon nanostructures in epoxy matrices

P. I. Xidas*, K. S. Triantafyllidis
Department of Chemistry, Aristotle University of Thessaloniki, Greece

The incorporation of inorganic nanoadditives in polymer matrices can significantly improve their performance properties or even to induce new properties. The addition of only a small fraction of nanofillers (e.g. ≤ 5 wt%) is sufficient for boosting polymers' properties, forming novel, lightweight and affordable nanocomposites. Towards this direction, polarity matching between inorganic-organic surfaces and homogeneous dispersion of nanofillers are critical.

In the present work, the synthesis and organic surface modification of various types of carbon nanostructures, as well as the effect of their incorporation in glassy and rubbery epoxy resins were studied. Three types of carbon nanostructures with different architecture were selected, carbon nanotubes (1-D), graphene oxide (2-D) and mesoporous carbons (3-D) and were organically modified with various alkylamines. Alkylamine-based molecules are considered to be one of the best choices for inducing organophilicity to the inorganic surface as well as for acting as curing agents for epoxy ring opening and resin polymerization. Addition of the parent (not modified) and organo-modified carbon nanostructures were added in various loadings to glassy and rubbery epoxy resins and the effects on performance properties (mechanical, thermo-mechanical, thermal, conductance, barrier) of the resulting nanocomposites were studied. The obtained results showed great improvements especially in mechanical strength and electric conductivity depending on the type of carbon nanoadditive and the nature (rigid or rubbery) of the epoxy polymer.

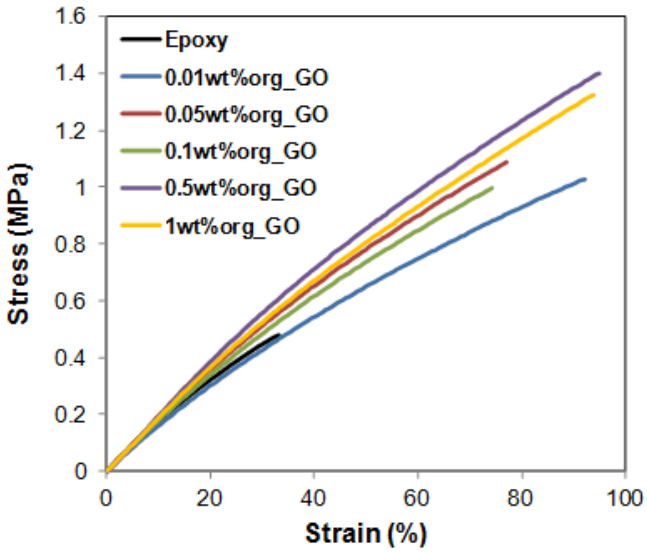

Figure 1: Stress-strain curves of rubbery epoxy nanocomposites reinforced with organically modified GO at various loadings

The ultimate technological target was the development of high performance multi-functional epoxy polymer nanocomposites for cutting edge applications such as electric and thermal conduction, adsorption, durable lightweight structural parts, cryogenic structural storage and more.

* pxidas.mail@gmail.com