Influence in the morphology of epoxy/PSU blends for modified RGO with PSU brushes

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Polymer matrix nanocomposites obtained by incorporating graphene sheets to polymeric matrices have attracted a greater attention in many scientific fields, due to the excellent properties provided by the nano-reinforcement. Specifically, graphene has been used to improve the mechanical, thermal, electrical, and barrier properties of polymers showing a great potential for applications in electronics, aerospace, automobile manufacturing, and green energy.[1],[2],[3].

Epoxy resins are widely used in many industry fields due to their inherent excellent thermal and mechanical properties. Nevertheless, in order to increase toughness and meet high performance applications, it is usual to introduce on the epoxy network some other materials, which include elastomers, thermoplastics, and all sorts of nanoparticles. Each one of these modifiers may alter deeply the properties of the thermoset network.

One useful way to improve epoxy resins toughness is to use high-performance engineering thermoplastic as modifiers,such aspoly(ether imides) andpoly(ether sulfones) (PSU). These have high glass transition temperatures, thermal stability, and toughness.Thermoplastics are usually partially miscible with epoxy resin precursors in several temperatures and composition ranges, but as curing progress, the entropy of mixing decreases and an immiscible two-phase structure is obtained by reaction-induced phase separation (RIPS). Morphology and performance ofepoxy/PSU blends has been extensively studied.[4],[5],[6]. Several morphologies, such as sea-island, bicontinuous or double-phase, and nodular (phase-inverted) structures have been observed.[7]

References

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In this work, reduced graphene oxide (RGO) sheets have been added to an epoxy/PSU blend containing 20% PSU by weight. To improve dispersion, RGO has been covalently modified with PSU brushes (RGO-PSU). Epoxy/PSU blends wereprepared by dissolving the thermoplastic in the epoxy monomer by mechanical stirring. The mixture was modified by dispersion of RGO or RGO-PSU up to 1% by weight on the epoxy precursors before curing. Acomparative study of the mechanical and electrical properties of these nanocompositesand the analysis of the influence of RGO on the final morphology have been performed.

Phase-inverted morphologies (PSU as continuous phase) have been observed. The interest in this morphology lies in the possibility of achieving the phenomena known as double threshold. Depending on the morphology it is possible to introduce channels where graphene sheets are preferably located.

The resulting epoxy/PSU/RGO nanocomposites were characterized by infrared spectroscopy, differential scanning calorimetry, andthermogravimetric analysis. The morphology and microstructure of the prepared samples were examined with a scanning electron microscopy (SEM). Nanocomposites showed interesting morphology changes inthe presence of RGO, which may be caused by RGO migration to the epoxy rich region during the phase separation because of its better affinity to the epoxy resin. The influence of modified RGO with PSU brushes has been also analyzed. Furthermore, samples were tested by dynamic mechanical thermal analysis (DMTA).

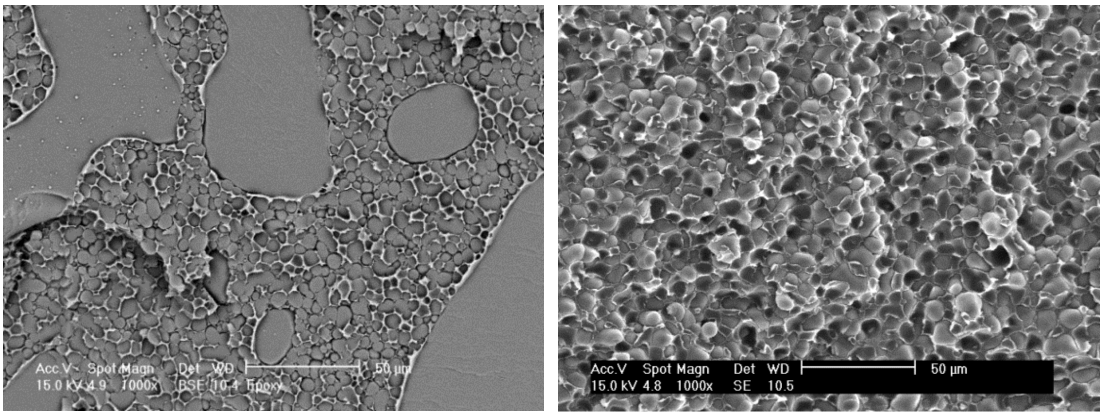

Figure 1:a) Fracture of epoxy/20PSU/nanocomposite, b) Fracture of epoxy/20PSU/1RGOnanocomposite.