MECHANICAL, THERMAL AND ELECTRICAL ENHANCEMENT OF EPOXY-BASED COMPOSITES USING NANOPARTICLE INFUSION AND HIGH MAGNETIC FIELDS

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Introduction

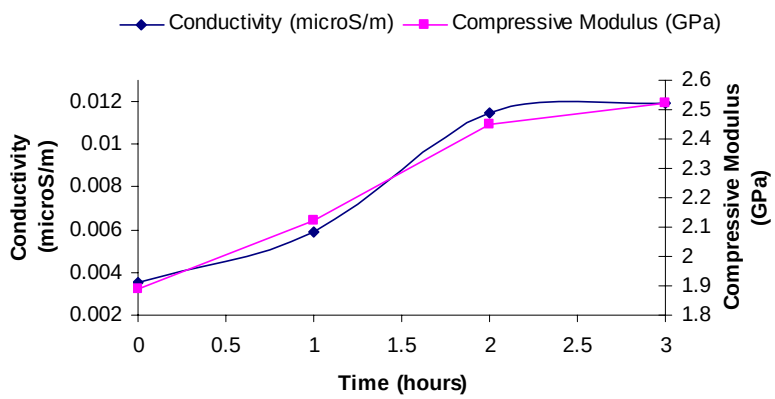
Investigations into the enhancement of mechanical properties of epoxy-based nanocomposites with high magnetic fields have continued. Our most recent experiments at NHMFL have continued with a pilot investigation of the use of coupling agents in the mix in an attempt increase the weight percent loading of nanoparticles. This investigation is ongoing. In the meantime, studies of the influence of high magnetic fields on a variety of physical properties have yielded interesting results that will be described in detail in a series of journal [1] and conference papers.

Experimental

In addition to the observed significant field-induced compressive modulus enhancement, (see Fig. 1), we have also observed an increase in storage moduli of ~ 220 MPa in SiC nanocomposites, in mechanical stiffness (~315 MPa) in TiO_2 nanocomposites. Additionally, SiC nanocomposites, cured in a 21T field showed a 12 ^{0}C increase in the glass transition temperature over samples cured in zero field. A sample result of our investigations [2] into field-induced modifications of dielectric and conductive properties is shown in the following section.

Results and Discussion

Fig. 1, seen below, typifies strong correlations observed, for various samples/materials, between electrical and mechanical properties of these composites. In this example shown, SiC NPs are dispersed (at a loading of 1% by wt.) in SC-15 epoxy resin. Equally close correlation was observed between this elastic modulus and dielectric constant in the same composite. Similar results have recently been observed in composites comprising 1% loadings of multi-walled carbon nanotubes.



Conclusions

The above-described enhancements of physical properties are sufficiently impressive as to warrant further investigation at significantly higher weight percentage nanoparticle loadings. Coupling agents employed to facilitate this have been unsuccessful so far but investigations are continuing.

References

[1] Mahfuz H. *et al.*, Materials Letters (2006),doi.10 1016/j.matlet.2006.09.065
[2] T. Al-Saadi, MS thesis, University of South Alabama, (2006)