Processing and Mechanical Characterization of Glass Fiber Reinforcements using GO Nano Particles

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Introduction

Recently, a new 2D material graphene, has triggered numerous fundamental and technological studies. Much like CNTs, graphene demonstrates excellent electrical and thermal conductivity with good mechanical properties. Also, the production cost of graphene can be much lower than CNTs. Derived from its excellent flexibility and large interfacial area, the graphene sheets may serve as suitable fillers for the enhancement of mechanical and electrical properties in composites materials.

Objective

The objective of this research is to investigate the processing and mechanical properties of graphene oxide (GO) nano particle reinforced glass fiber composites using LCM processing.

Methodology

GO was synthesized from graphite powder by the modified Hummers method . The graphite oxide suspension was diluted to 5 mg/ml, and was then mixed with epoxy resin (Prime 20 LV) using ultrasonication and mechanical stirring. Three different percentages of GO (0.05, 0.1 and 0.2%) were obtained. The samples were tested for viscosity and DSC. After that, samples were prepared using the VARTM process. Coupons were cut and were subjected to flexure and low velocity impact tests.

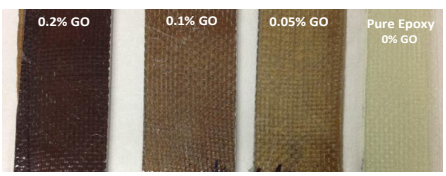

Figure 1: Glass/GO epoxy composites

Results

- DSC and Resin Rheology

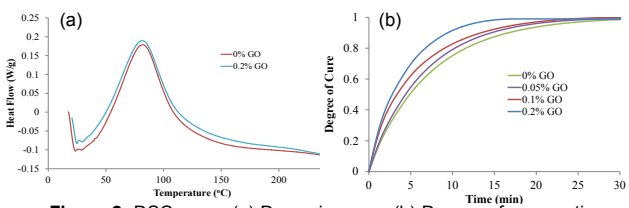

Figure 2: DSC scans (a) Dynamic scan, (b) Degree of cure vs time

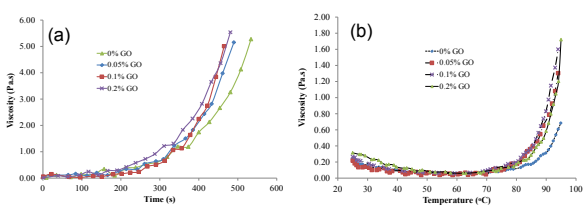

Figure 3: Viscosity measurements (a) Isothermal scan at 80°C (b) temperature sweep

- VARTM processing

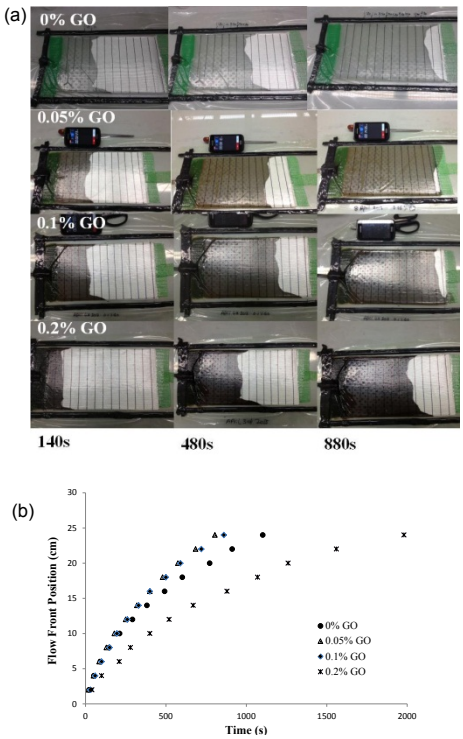

Figure 4: VARTM manufacturing (a) photos of flow front progression, (b) flow front position vs time.

- Flexural Strength and Low Velocity Impact Response

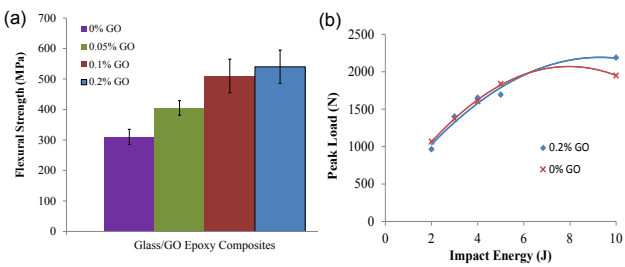

Figure 5: Summary of the mechanical characterization tests (a) flexural strength, (b) low velocity impact response.

Conclusions

The addition of graphene oxide to the neat epoxy resin system increased the viscosity, hence mold filling times increased. On the other hand, the addition of GO particles effected the curing behavior of the resin, causing premature gelation, hence reducing the processing window at higher GO content. The mechanical test results show promising results, an increase in flexural strength was noted. The low velocity impact was also improved at higher GO content.

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