Nanocomposites based on tetraethylenepentamine-modified graphene oxide/epoxy

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Keywords: *Graphene oxide, functionalization, tetraethylenepentamine, epoxy, nanocomposite, thermomecanical properties.*

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Introduction

Nanocomposites based on epoxy/graphene have been investigated to enhance thermomechanical performance[1,2]. In this work, graphene oxide nanosheets (GO) were modified with tetraethylenepentamine (GO-TEPA) in a fast and compact reaction, assisted by microwave radiation. Composites containing 0.1, 0.3 and 0.5 wt.% of GO and GO-TEPA were produced.

Results and discussion

The graphene structure and morphology were characterized by microscopies and spectroscopies, Fig.1 exemplifies two images. Fig.2(a,b) shows the thermal conductivities (*k*) and nanoindentation curves for epoxy and composites. Increases of ~20 ºC in glass transition (T_g) and gains of up to 103% in thermal conductivities (obtained by flash laser) were achieved for composites containing 0.5 wt.% of GO-TEPA in epoxy when compared to neat polymer (Table 1). Nanoindentation analyses showed significant increases of 72% in Young's modulus and 143% in hardness for the same sample (Table 1).

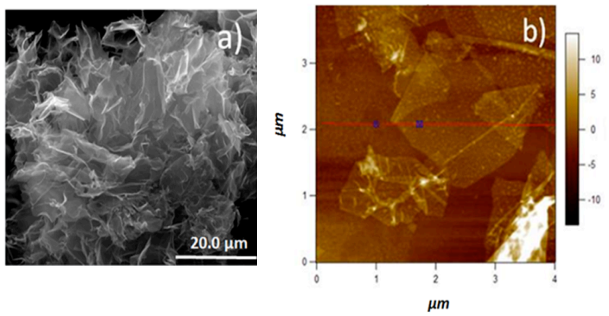

Fig.1 (a) SEM micrograph of GO, (b) AFM image of GO-TEPA.

The results indicate that the improvement in properties depends strongly on the degree of the chemical modification of the GO nanosheets dispersed in the polymer matrix.

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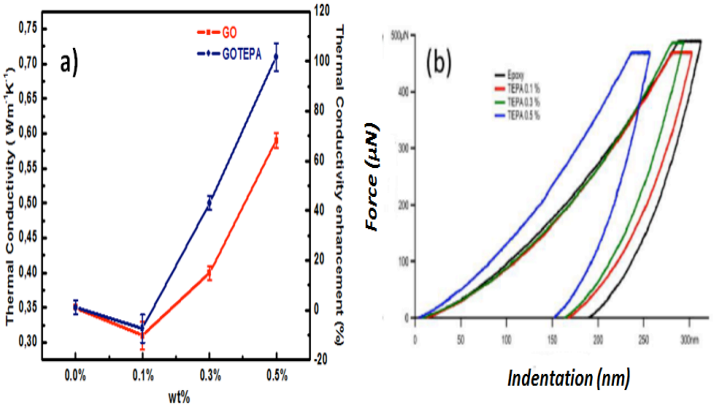

Fig.2 Thermal conductivity (a) and nanoindentation curves (b) for epoxy and composites.

Table.1 Average values of the modulus of elasticity (*E*), hardness (*H*), relation hres/hmax obtained by nanoindentation, thermal conductivity (*k*) and T_g of pure epoxy and composites produced with GO and GO-TEPA with different wt %.

Sample	% w/w	E (GPa)	H (GPa)	(*k*) W/m.K	T_g (°C) (DSC)
Epoxy	0.0	(3.3±0.1)	(0.28±0.02)	0.35±0.01	124.2±0.3
GO	0.1	(3.0±0.2)	(0.27±0.02)	0.31±0.02	137.1±0.4
	0.3	(2.8±0.1)	(0.26±0.01)	0.40±0.01	138.3±0.2
	0.5	(3.2±0.2)	(0.38±0.03)	0.59±0.01	139.4±0.3
GO-TEPA	0.1	(3.3±0.1)	(0.33±0.01)	0.32±0.02	139.0±0.5
	0.3	(3.5±0.2)	(0.31±0.02)	0.50±0.01	140.4±0.1
	0.5	(5.7± 0.1)	(0.68±0.02)	0.71±0.02	143.4±0.4

Conclusions

Simultaneous gains in thermal and mechanical properties characterize these materials as multifunctional nanocomposites.

Acknowledgements

Petrobras is acknowledged for financial support. H. Ribeiro is grateful to CNPq. Instituto Nacional de Ciência e Tecnologia em Nanomateriais de Carbono, Departamento de Química and Centro de Microscopia/UFMG.