INTERFACE INVESTIGATION OF HYBRID POLYMER COMPOSITES WITH GRAPHENE-MODIFIED MATRIX

Nikos Koutroumanis[1,2], Anastasios C. Manikas[1,2], Panagiotis Nektarios Pappas[1], Costas Galiotis[1,2,*]

[1]Institute of Chemical Engineering Sciences, Foundation of Research and Technology, Hellas, Platani St., 26504, Patras, Greece.

[2]Deparment of Chemical Engineering, University of Patras, 26504, Patras, Greece

(*c.galiotis@iceht.forth.gr)

ABSTRACT

The role of interface-interphase is by definition one of the most important subjects of study in the field of advanced polymer-based composites. It is well established that the level of interfacial adhesion between the host medium and the inclusions dominates the stress transfer mechanism between the 'weak' matrix and the 'strong' reinforcing phase. Also, it is widely accepted that a composite with good mechanical properties requires an optimum interface [1].

Graphene nanoplatelets (GNPs) can be considered as short stacks of individual (or very few) layers of graphite. Since the introduction and development of graphene a few years ago, the production cost of GNPs (in several types and grades) follows a decreasing trend, so they cannot still be considered as high cost materials for use as fillers. Inclusion of graphene nano-platelets (GNPs) in epoxy has been shown to improve mechanical and electrical properties with respect to the unmodified epoxy, thus triggering the research on using epoxy/GNP systems as a host matrix in several composite applications. The resulting hybrid composite can potentially exhibit enhanced mechanical properties in respect to traditional carbon fiber composites [2-3].

In this work, we aim to present an experimental study of the interfacial strength of carbon fibre reinforced composites after modification of the host epoxy matrix by means of mixing with graphene nanoparticles. This method introduces graphene nano-platelets (GNPs) directly dispersed in the host epoxy system and exhibits an additional interface enhancement that can reach 50% in the case of 3 wt% GNPs' concentration. The interfacial properties of the modified system are evaluated by using single CF filament model composites and adopting Raman spectroscopy combined with the basic principles of the shear lag theory. The calculated shear lag parameter (β-parameter) was used as a criterion to compare the studied pristine and modified systems. Also, several mechanical testing techniques were implemented, (tensile testing, interlaminar shear stress measurements) in order to evaluate and quantify the contribution of GNPs' inclusions to the macro mechanical properties of the composite materials.

REFERENCES

[1] Miguel A. Montes-Moran, Robert J. Young. (2002) *Carbon,* 40:857-875.

[2] N. Koutroumanis, A. C. Manikas, P. N. Pappas, F. Petropoulos, L. Sygellou, D. Tasis, K. Papagelis, G.Anagnostopoulos,C. Galiotis. (2018) *Composite Science and Technology*, 157:178-184.

[3] Rafiee MA, Rafiee J, Wang Z, Song HH, Yu ZZ, Koratkar N. (2009) *ACS Nano*, 3:3884-3890.