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PII: S1359-835X(17)30020-9
DOI: http://dx.doi.org/10.1016/j.compositesa.2017.01.007
Reference: JCOMA 4542

To appear in: *Composites: Part A*

Received Date: 14 October 2016
Revised Date: 5 January 2017
Accepted Date: 7 January 2017

Please cite this article as: Li, Y., Zhang, H., Porwal, H., Huang, Z., Bilotti, E., Peijs, T., Mechanical, Electrical and Thermal Properties of *In-situ* Exfoliated Graphene/Epoxy Nanocomposites, *Composites: Part A* (2017), doi: http://dx.doi.org/10.1016/j.compositesa.2017.01.007

Mechanical, Electrical and Thermal Properties of *In-situ* Exfoliated Graphene/Epoxy Nanocomposites

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***Keywords*:** *In-situ* exfoliation, few layer graphene, graphite nanoplatelets, epoxy resin

ABSTRACT

Depending on processing conditions, *in-situ* exfoliated graphite nanoplatelets (GNP) with low defect content and average aspect ratios up to 300-1000 and thicknesses of 5-17 nm could be produced by three roll milling (TRM). This paper focuses on the mechanical, electrical and thermal properties of *in-situ* GNP/epoxy nanocomposites, evaluated in terms of simple analytical models. Good mechanical reinforcement (160% increase in flexural modulus @ 4 wt.% GNP), electrical conductivity (~10^{-2} S/m @ 3 wt.% GNP with a percolation threshold of 0.52 vol.%) and thermal conductivity (0.70 $W \cdot m^{-1} \cdot K^{-1}$ @ 5 wt.% GNP) were obtained. The production of GNP-filled resins using TRM technology can potentially remove important cost barriers for GNP modified plastics, composites and coatings as compared to traditional multi-step solvent based exfoliation methods.

1 INTRODUCTION

Interest in graphene and its potential applications has grown rapidly since 2004, when the material was first isolated [1, 2]. Graphene is a one-atom thick planar sheet and an emerging class of nanomaterials with remarkable properties, such as, high thermal conductivity (~5000 $W \cdot m^{-1} \cdot K^{-1}$) [3], electrical conductivity (10^8 $S \cdot m^{-1}$) [4], high intrinsic mobility (2×10^5 $cm^2 \cdot s^{-1} \cdot v^{-1}$) [5], extremely high tensile strength (~130 GPa), Young's modulus (~1.0 TPa) [6], and large specific surface area