Solid State Phenomena
ISSN: 1662-9779, Vol. 264, pp 58-61
doi:10.4028/www.scientific.net/SSP.264.58

Submitted: 2016-10-30
Revised: 2017-03-08
Accepted: 2017-06-05
Online: 2017-09-20

Influence of Hydroxyl and Carboxyl Functionalized Multi-Walled Carbon Nanotube and Filler Loading on the Tensile Properties of Epoxy Composites

Ervina Junaidi[1,2,a], Mariatti Jaafar[1,b*] and Sinin Hamdan[2,c]

[1]School of Materials and Mineral Resources Engineering, Universiti Sains Malaysia, Engineering Campus, 14300 Nibong Tebal, Penang, Malaysia.

[2]Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Malaysia.

[a]ervinajunaidi@yahoo.com, [b*]mariatti@usm.my, [c]hsinin@unimas.my

Keywords: Functionalized multi-walled carbon nanotube, epoxy, tensile properties

Abstract. In this study, three various types of fillers; pristine multi-walled carbon nanotube (MWCNT), hydroxyl functionalized multi-walled carbon nanotube (MWCNT-OH) and carboxyl functionalized multi-walled carbon nanotube (MWCNT-COOH) were used to prepare epoxy (EP) composites via ultrasonication and casting techniques. The effect of pristine and functionalized MWCNT as well as fillers loading (0-1.0 vol%) on tensile properties of EP composites were investigated and compared. To identify the effectiveness of functional groups on the EP composites, the MWCNT, MWCNT-OH and MWCNT-COOH were compared via tensile testing. The addition of 0.4 vol% pristine MWCNT decreased the material's tensile strength and modulus by 5.13% and 2.82% respectively, while the addition of MWCNT-OH decreased the material's tensile strength by 12.80%. However, among the EP composites, the 0.4 vol% MWCNT-COOH/EP composite exhibited a 12.82% increase in tensile strength. The Young's modulus of 0.4 vol% MWCNT-OH/EP and MWCNT-COOH/EP composites were found to be significantly higher compared to unfilled EP which were approximately 15.60% and 18.54% respectively. The effect of functionalized MWCNT was supported by morphological analysis, which demonstrated an improvement in MWCNT-COOH dispersion with slightly fine agglomerates particles at 0.4 vol%.

Introduction

The discovery of carbon nanotubes (CNT) by Sumio Iijima in 1990s has led to revolutionary changes in numerous field of research. Theoretical and experimental investigations revealed that CNT have superior structural and functional properties for many useful applications. CNT/epoxy (EP) composites have been widely investigated as a result of their excellent mechanical, thermal and electrical properties. Many researchers have reported significant findings of CNT/EP composites properties, although some challenging issues related with dispersion of CNT during processing and CNT/EP interfacial adhesion remain to be solved for further improvements [1]. Therefore, functionalization of CNT has been suggested in previous works as it is the most effective way to provide multiple bonding sites to the EP resin and subsequently can enhance compatibility between CNT and EP resin [2]. Among various functionalities onto CNT surface, chemical functionalization has demonstrated to be suitable in preserving the stable bonds [3].

Limited research has been conducted on the effect of oxygen-containing functional groups such as hydroxyl (-OH) and carboxyl (-COOH) created on the MWCNT via the chemical functionalization. In this research work, the effect of commercial pristine multi-walled carbon nanotube (MWCNT), hydroxyl functionalized multi-walled carbon nanotube (MWCNT-OH) and carboxyl functionalized multi-walled carbon nanotube (MWCNT-COOH) along with fillers loading (0-1.0 vol%) on tensile properties of EP composites were investigated and compared. The incorporation of -OH and -COOH functionalized MWCNT into EP resin is believed to enhance CNT/EP interfacial adhesion.