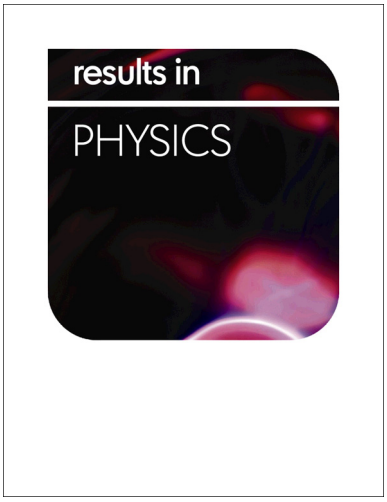

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Thermal Characteristics of Carbon Fiber Reinforced Epoxy Containing Multi-walled Carbon Nanotubes

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ABSTRACT

The material with irregular atomic structures such as polymer material exhibits low thermal conductivity because of the complex structural properties. Even materials with same atomic configurations, thermal conductivity may be different based on their structural properties. It is expected that nanoparticles with conductivity will change non-conductive polymer base materials to electrical conductors, and improve the thermal conductivity even with extremely small filling amount. Nano-composite materials contain nanoparticles with a higher surface ratio which makes the higher interface percentage to the total surface of nanoparticles. Therefore, thermal resistance of the interface becomes a dominating factor determines the effective thermal conductivity in nano-composite materials. Carbon fiber has characteristic of resistance or magnetic induction and Also, Carbon nanotube(CNT) has electronic and thermal property. It can be applied for heating system. These characteristic are used as heating composite. In this research, the exothermic characteristics of Carbon fiber reinforced composite added CNT were evaluated depend on CNT length and particle size. It was found that the CNT dispersed in the resin reduces the resistance between the interfaces due to the decrease in the total resistance of the heating element due to the addition of CNTs. It is expected to improve the life and performance of the carbon fiber composite material as a result of the heating element resulting from this paper.

Keywords: Carbon Nanotube(CNT), Carbon Fiber Reinforcement Plastic(CFRP), Heater, Exothermic Characteristics

1. INTRODUCTION

The favorable strength to weight ratio of carbon fibers and their excellent mechanical properties have led to their use in diverse applications such as aerospace, sports and transport sectors. Poly acrilonitrile (PAN) based carbon fibers are not only mechanically strong but also possess electrical resistivity in a range to make it suitable for heating devices (Haheshwari & Mathur, 2014).

Thermal conductivity of the material occurs by phonons' traveling through a medium. In the material with regular atomic structure displays high thermal conductivity due to the fast travel of phonons through regular coupling structure. Additionally, the material's regular atomic structure maintains a consistent thermal conductivity. However, a material with irregular atomic structures such as polymer material exhibits low thermal conductivity because of the complex structural properties. Even materials with same atomic configurations, thermal conductivity may be different based on their structural properties. A polymer material is formed by multiple polymer chains entwined, made of repeated monomers' atomic structures. In general, the thermal conductivity in a single polymer chain formed by covalent bonds, as phonons travel fast through covalent bonds. On the other hand, the thermal conductivity between non-covalent bond chains, such as van der Waals bonds, is relatively slow because of phonons' reflection and scattering phenomena between the chains. Thus, even in polymer materials formed from same monomers, depends on the length, structure of polymer chains and the various conditions including the arrangement and density, chains may display different thermal conductivities (Yoo, 2013). Composite materials consist of materials bigger than a micrometer size have very few interface compared to the total volume, that the thermal conductivity of the interface