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Electrophoretic Deposition (EPD) of Multi-Walled Carbon Nanotubes (Mwcnts) Onto Carbon Fiber (CF) Fabric

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Abstract: The Fiber Reinforced Polymer Composite (FRPC) has been widely employed in structural applications. However, adding nanoparticles such as multi-walled carbon nanotubes (MWCNTs) can be used to improve the composites' mechanical properties substantially. The purpose of this study is to investigate the stability of MWCNTs in distilled water (DW) and dimethylformamide (DMF). Electrophoretic deposition (EPD) was chosen as the method for depositing MWCNTs onto carbon fiber (CF) fabric because of the advantages of simple equipment and inexpensive cost. Thus, the effect of voltage and deposition time were examined to attain the ideal condition for the EPD of MWCNTs onto CF fabric. The stability of dispersed MWCNTs in various dispersing mediums was explored as the importance of the MWCNTs to remain stable in the medium is essential to achieve homogeneous deposition. The UV-Vis and colloidal stability test revealed that MWCNTs dispersed in DMF have greater stability than DW. Scanning Electrode Microscopy (SEM) images exhibited that 10 minutes and a 20 V voltage were the optimal conditions for the deposition of MWCNTs onto CF fabric.

Keywords: Electrophoretic deposition, colloidal stability, multi-walled carbon nanotubes

1. Introduction

Fiber reinforced polymer composite has been extensively used as a primary load-bearing structure in the aerospace industry. Carbon fiber (CF) is widely used as a fiber component in a composite due to its low densities and superior mechanical properties [1,2]. The previous researcher reported that the fiber is used to improve the performance of polymer composite in the form of fatigue performance, strength, and specific stiffness. However, the interfacial and compression properties of the fiber-reinforced polymer composite are dependent on the interface between the fiber and the matrix [3]. For a continuous fiber-reinforced composite, the interface between the fiber and matrix is critical as it acts as a bridge that transfers load between the fiber and the matrix through shear flow, therefore, it is challenging for composites with high interfacial shear strength to transfer stress for reinforcement purposes [4]. However, the advancement of technology has introduced a hierarchical structure to improve the interfacial strength of fiber composite [5]. Among several nanomaterials available, carbon nanotubes (CNTs) have been introduced into conventional fiber composite due to their remarkable thermal and electrical properties, and outstanding modulus and strength [6].

Direct mixing, electrophoretic deposition (EPD), chemical vapour deposition (CVD) growth coating, and dip coating are some of the methods utilized to integrate nanofillers. EPD has proven to be useful for depositing CNTs onto fiber surfaces, probably due to its low cost, ease of use, uniformity of deposits, microstructural homogeneity, and lower electric potential requirements [7]. In the field of carbonaceous materials, EPD is attracting interest for controlling

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