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Effect of CNT/CNC hybrid nanofiller on PVA/CNT/CNC nanocomposite

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ABSTRACT

The idea of using a hybrid nanofiller comprised of two or more filler materials with different dimensionality can lead to a strong synergistic effect, surpass the performance of the individual filler and achieve its highest potential for improving the performance of nanocomposites. In this research, CNT/CNC hybrid filler was prepared by mixing the 6 w.t% of CNC with 0.2 g, 1.2 g, 2.2 g, 3.2 g, and 4.2 g of carbon nanotubes, respectively. The hybrid nanofiller produced was labeled as 0.2 CNT/CNC, 1.2 CNT/CNC, 2.2 CNT/CNC, 3.2 CNT/CNC, and 4.2 CNT/CNC. Subsequently, the CNT/CNC hybrid nanofiller was added as the reinforcement in 5 w.t% of polyvinyl alcohol (PVA) matrix to produce the CNT/CNC/PVA nanocomposite films using the solvent casting method. The CNC/CNC hybrid filler was characterized using viscometer and stability test while the CNT/CNC/PVA nanocomposite films were characterized using optical microscope (OM) and field emission scanning electron microscope (FESEM). The result showed that the stability of the hybrid filler could be sustained in one phase for up to 5 months. The highest viscosity of hybrid filler was at 4.2 g CNT/CNC hybrid nanofiller with 193.0 centipoises, cP. The morphology of CNT/CNC/PVA nanocomposite films from optical microscope and field emission scanning electron microscope (FESEM) revealed homogenous dispersion of hybrid nanofiller within the PVA matrix, and demonstrated the viscosity became higher due to high amounts of CNT. In conclusion, CNT/CNC can be an effective hybrid nanofiller for PVA matrix reinforcement for flexible, robust, high-performance nanocomposite.

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1. Introduction

Use of a variety of nature-based nanomaterials effectively has significant environmental benefits, as well as excellent physicochemical features and excellent performance. Algal cellulose, bacterial cellulose, cotton linters, microcrystalline cellulose, sugarcane bagasse pulp, rice husk, wheat straw, and wood pulp are also some of the raw materials. These nanocrystals provide enticing combinations of bio-physicochemical properties such as biocompatibility, biodegradability, light in weight, biocompatibility, stiffness, liquid crystallinity, degradability, sustainability, optical transparency, low thermal expansion, gas impermeability, adaptable surface chemistry, and improved mechanical properties [1]. These nanocrystals can also be used to replace some petrochemical-based goods and inexpensive than similar high-performance nanomaterials. Cellulose nanocrystals (CNC) has both amorphous and highly ordered crystalline cellulose structures. CNC keeps its exhibition, yet in addition shows other overpowering benefits through its measurements, for example 5–20 nm in width with lengths up to many nanometres (100 ~ 600 nm). Conse-

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