Investigating Mechanical and Electrical Properties of Nanocomposites with aligned graphene

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Abstract

In this study, we fabricated nanocomposites containing graphene platelets aligned in a specific direction to assess their potential for strain measurement with the characteristics of resistance. To disperse the graphene platelets within epoxy resin, we employed mechanical mixing and subsequent sonication. Following that, we subjected the graphene-epoxy mixture to an electrical field for 20 minutes to achieve alignment of the graphene platelets [1]. Through real-time microscopy, we observed that under the influence of the electric field, the graphene platelets underwent rotation, translation, and eventually formed chain-like structures along the field direction. We evaluated the electrical conductivity of the nanocomposites with varying graphene loadings using an electrometer. The results indicated that when the graphene loading reached 0.15 wt%, the electrical conductivity of the nanocomposites approached the percolation threshold. Approaching the percolation threshold implies that the electrical resistance of the material significantly changes in response to axial elongation. To assess strain variation and determine the electrical resistance of the nanocomposites, we prepared coupon specimens with 0.15 wt% aligned graphene platelets and conducted tensile tests while employing conventional strain gauges. The results revealed that the nanocomposites with aligned graphene exhibited high resistance to axial deformation, suggesting their potential for strain measurement applications. Additionally, we investigated the mechanical properties of the aligned graphene nanocomposites [2]. Tensile tests were conducted on the nanocomposites in the direction of graphene alignment using a material test machine. Furthermore, we employed electrical microscopy to examine the fracture surfaces of the specimens and characterize the corresponding failure mechanisms. The findings demonstrated that the nanocomposites with aligned graphene displayed superior tensile moduli and strength compared to those with randomly oriented graphene. Moreover, the incorporation of functionalized graphene resulted in improved interfacial properties and enhanced mechanical performance in the nanocomposites compared to pristine graphene.

Keywords: Aligned graphene, Nanocomposites, Mechanical properties, Electrical properties

References

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