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Development of High-Performance Conductive Polybenzoxazine/Graphite-Copper Nanoomposite for Electromagnetic Interference Shielding Applications

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Abstract : In recent years, extensive attention has been given to the study of conductive nanocomposites due to their unique properties, which are dependent on their size and shape. The potential applications of these materials include electromagnetic interference shielding, energy storage, photovoltaics, and others. These outstanding properties have led to increased interest and research in this field. In this work, a conductive poly benzoxazine nanocomposite, PBZ/Gr-Cu, was synthesized through a compression molding technique to achieve a high-performance material suitable for electromagnetic interference (EMI) shielding applications. The microstructure of the nanocomposites was analyzed using scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FTIR). The thermal stability, electrical conductivity, and EMI shielding properties of the nanocomposites were evaluated using thermogravimetric analysis, a four-point probe, and a VNA analyzer, respectively. The TGA results revealed that the thermal stability and electrical conductivity of the nanocomposites were significantly enhanced by the incorporation of Gr/Cu nanoparticles. The nanocomposites exhibited a low percolation threshold of about 3.5 wt.% and an increase in carrier concentration and mobility of the carriers with increasing hybrid nanofiller content, causing the composites to behave as n-type semiconductors. These nanocomposites also displayed a high dielectric constant and a high dissipation factor in the frequency range of 8-12 GHz, resulting in higher EMI shielding effectiveness (SE) of 25-44 dB. These characteristics make them promising candidates for lightweight EMI shielding materials in aerospace and radar evasion applications.

Keywords : polybenzoxazine matrix, conductive nanocomposites, electrical conductivity, EMI shielding
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