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Boron Nitride Nanoparticle Enhanced Prepreg Composite Laminates

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Abstract : Low specific weight and high strength is the basic requirement for aerospace materials. Fiber-reinforced epoxy resin composites are attractive materials for this purpose. Boron nitride nanoparticles (BNNPs) have good radiation shielding capacity, which is very important to aerospace materials. Herein a processing route for an advanced hybrid composite material is demonstrated by introducing dispersed BNNPs in standard prepreg manufacturing. The hybrid materials contain three parts: E-fiberglass, an aerospace-grade epoxy resin system, and BNNPs. A vacuum assisted resin transfer molding (VARTM) was utilized in this processing. Two BNNP functionalization approaches are presented in this study: (a) covalent functionalization with 3-aminopropyltriethoxysilane (KH-550); (b) non-covalent functionalization with cetyltrimethylammonium bromide (CTAB). The functionalized BNNPs were characterized by Fourier-transform infrared spectroscopy (FT-IR), X-ray diffraction(XRD) and scanning electron microscope (SEM). The results showed that BN powder was successfully functionalized via the covalent and non-covalent approaches without any crystal structure change and big agglomerate particles were broken into platelet-like nanoparticles (BNNPs) after functionalization. Compared to pristine BN powder, surface modified BNNPs could result in significant improvement in mechanical properties such as tensile, flexural and compressive strength and modulus. CTAB functionalized BNNPs (CTAB-BNNPs) showed higher tensile and flexural strength but lower compressive strength than KH-550 functionalized BNNPs (KH550-BNNPs). These reinforcements are mainly attributed to good BNNPs dispersion and interfacial adhesion between epoxy matrix and BNNPs. This study reveals the potential in improving mechanical properties of BNNPs-containing composites laminates through surface functionalization of BNNPs.

Keywords : boron nitride, epoxy, functionalization, prepreg, composite
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