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Novel Self-Healing CFRP Composites with High Glass Transition Temperatures

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ABSTRACT

Carbon fiber reinforced polymer (CFRP) composites were fabricated using a novel intrinsically healable isocyanurate-oxazolidone (ISOX) thermosetting matrix. After multiple delamination events, repeatable strength recovery of the composites has been demonstrated with a first healing efficiency up to 85% after thermal treatment. The healing mechanism results from transformation of the isocyanurate with epoxide groups to yield new oxazolidone rings at the fracture surface. This novel ISOX polymer utilizes commercial diglycidyl ether of bisphenol F (DGEBF) and toluene diisocyanate to produce a high cross-link density thermoset with a glass transition temperature (T_g) up to 285°C, and 99.5% of the composite weight remains at 300°C. The strength and stiffness of the composites are comparable with an engineering grade polymer matrix composite typically used in aerospace applications and the thermal stability places the materials in the polybismaleimide performance region although with greater toughness. This polymer exhibits the highest T_g of any