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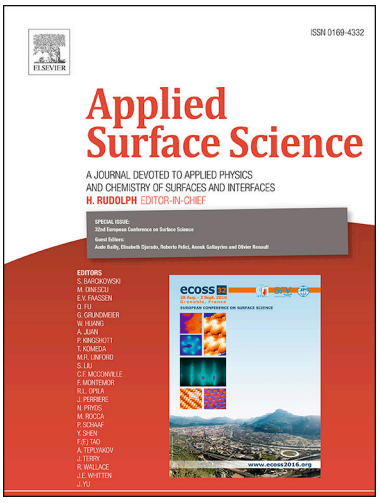

Full Length Article

Evaluation of the effect of PyC coating thickness on the mechanical properties of T700 carbon fiber tows

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Evaluation of the effect of PyC coating thickness on the mechanical properties of T700 carbon fiber tows

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Abstract： Nanostructured uniform pyrolytic carbon（PyC）coatings with different thicknesses were prepared on surface of T700 carbon fiber by chemical vapor deposition (CVD). The effect of coating on tensile strengths of the carbon fibers was studied by tow tensile strength test. The morphological change, roughness, microstructures, and thermal stability of carbon fibers with PyC coating (PyC-C_f) were investigated by SEM, AFM, XRD, Raman, and Tg. It was found that with increase of the deposition time, the thickness of coating varied from 100 to 320 nm with increase in coating surface roughness. The coating adhered well with the carbon fiber substrates and the coating thickness is uniform. The oxidation resistance of PyC-C_f was significantly higher than uncoated carbon fibers. However, the fiber became brittle after the coating and the coating is very sensitive to tensile stresses, which decreased the tensile strength of the fiber tows. The tensile strength measurement revealed that the carbon fiber with a 100nm thickness of PyC coating maintained ~69.4% of its original strength, and the 320nm thickness of PyC-coated fibers showed the lowest strength because of the embrittlement caused by the PyC coating.

Keyword： PyC coating; coating thickness; carbon fiber tow; mechanical properties; Weibull distribution

1. Introduction

Due to their extremely high Young's modulus, high specific strength, and low density caused by a unique structure, carbon fibers (C_f) are widely used in advanced fiber reinforced composites, such as C_f/Carbon [1-6], C_f/Metal [7-11], C_f/Ceramic [12.13] and C_f/Polymer composites [14.15] etc. However, the carbon fiber reinforced composites usually cannot perfectly reflect all advantages of the carbon fiber and matrix as expected due to some reasons: Firstly, the undesirable matrix-interface reactions cause strong bonding or brittle phase. Formation of a brittle phase at the interface between the carbon fiber and matrix has been reported in some C_f/Mg composites, which lead to the poor fiber/matrix interfacial bonding [16.17]. Secondly, carbon fibers are oxidized during processing of composites. Oxidization of carbon fibers usually occurs at 450 °C, and the processing of C_f/Carbon, C_f/Metal, C_f/Ceramic are all in high temperatures environment. Therefore, the strength of the fibers diminishes due to the oxidation and chemical reaction during the composite fabrication process and thus limiting its use [18.19]. Thirdly, the composites have weak bonding due to the inert and smooth surface of carbon fibers, especially for carbon fiber reinforced resin matrix composites. It is widely accepted that the overall