Fabrication and Characterization of Al2O3 Based Electrical Insulation Coatings Around SiC Fibers

Authors : S. Palaniyappan, P. K. Chennam, M. Trautmann, H. Ahmad, T. Mehner, T. Lampke, G. Wagner

Abstract : In structural-health monitoring of fiber reinforced plastics (FRPs), every single inorganic fiber sensor that are integrated into the bulk material requires an electrical insulation around itself, when the surrounding reinforcing fibers are electrically conductive. This results in a more accurate data acquisition only from the sensor fiber without any electrical interventions. For this purpose, thin nano-films of aluminium oxide (Al_2O_3)-based electrical-insulation coatings have been fabricated around the Silicon Carbide (SiC) single fiber sensors through reactive DC magnetron sputtering technique. The sputtered coatings were amorphous in nature and the thickness of the coatings increased with an increase in the sputter time. Microstructural characterization of the coated fibers performed using scanning electron microscopy (SEM) confirmed a homogeneous circumferential coating with no detectable defects or cracks on the surface. X-ray diffraction (XRD) analyses of the as-sputtered and 2 hours annealed coatings (825 & 1125 ˚C) revealed the amorphous and crystalline phases of Al_2O_3 respectively. Raman spectroscopic analyses produced no characteristic bands of Al_2O_3, as the thickness of the films was in the nanometer (nm) range, which is too small to overcome the actual penetration depth of the laser used. In addition, the influence of the insulation coatings on the mechanical properties of the SiC sensor fibers has been analyzed.

Keywords : Al_2O_3 thin film, electrical insulation coating, PVD process, SiC fibre, single fibre tensile test

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