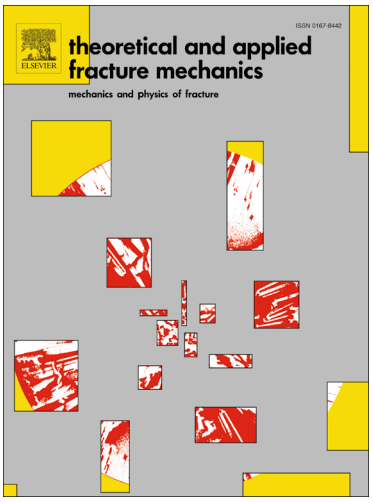

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Abstract

An epoxy matrix incorporated with hybrid multi-walled carbon nanotube (MWCNT) and nanosilica was used to fabricate woven carbon fabric epoxy composites using vacuum-assisted resin infusion molding (VARIM). Three types of multi-scale hybrid composites containing 0.2 wt. % MWCNT + 0.7 wt. % nanosilica, 0.7 wt. % MWCNT+ 0.2 wt. % nanosilica, and 0.45 wt. % MWCNT + 0.45 wt. % nanosilica were prepared to investigate both tensile and tribological properties, simultaneously. The results of tensile and tribological experiments showed that specimens containing 0.45 wt. % MWCNT + 0.45 wt. % nanosilica were better than the corresponding single-type nanoparticles with the same total weight percentages. Especially, the tensile strength and tensile modulus of composite specimens containing 0.45 wt. % MWCNT + 0.45 wt. % nanosilica increased by 25.2 % and 31 % in comparison with the neat composites, while their friction coefficient and wear rate decreased by 88 % and 98 % in comparison with the neat composites, respectively. The SEM images of fracture surfaces showed that the incorporation of nanoparticles enhanced the fiber–matrix interfacial strength, toughened the surrounding matrix, and improved resin adhesion to the fiber, which increased tensile properties of incorporated composites with hybrid nano-fillers. Moreover, by adding the hybrid nanoparticles to the unfilled carbon fabric composites, the friction coefficient variation of these specimens totally changed, which led to an improvement in the friction-reducing ability and wear rate resistance. In conclusion, a method is suggested in this paper to incorporate hybrid nanoparticles for benefitting from the properties of both nanoparticles at higher weight percentages.