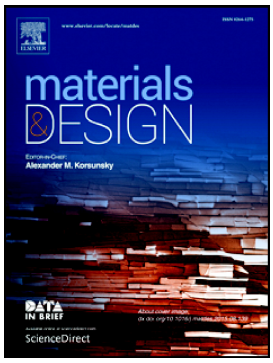

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The Loading-Rate Dependent Tensile Behavior of CNT Film and its Bismaleimide Composite Film

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Abstract

Carbon nanotube (CNT) macroscopic assembly, as a promising candidate for the protective and anti-collision materials, has attracted lots of researchers to explore its mechanical behavior under different loading rates. In this paper, the loading-rate dependent mechanical behavior of CNT film and its composite with bismaleimide (BMI) matrix is investigated. The pristine CNT film shows decreased tensile strength by 33.8% when the loading rate increases from 0.05 mm/min to 40 mm/min. An obvious necking extending phenomenon is observed in the CNT film during the tensile test under lower tensile rates, e.g. 0.05 mm/min and 0.5 mm/min. However, the random composite film and the oriented composite film both display increased tensile strength, by 58.2% and 35.7% respectively, with the increasing loading rate from 0.05 mm/min to 40 mm/min. The different loading-rate dependence of tensile behavior is ascribed to the different tensile-induced motions of CNTs and CNT bundles in composite film. Moreover, strain rate sensitivity coefficients of different film are calculated according to a simplified Johnson-Cook model. The results suggest that the pristine CNT film with the strain rate sensitivity coefficient of -0.0941 has a high loading-rate sensitivity, meanwhile polymer infiltration and oriented alignment can weaken the loading-rate sensitivity of CNT film.

Key words: carbon nanotube film, polymer composite, tensile properties, loading-rate sensitivity