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Twist induced plasticity and failure mechanism of helical carbon nanotube fibers under different strain rates

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Abstract: Twist has been well identified as an effective parameter to tune the mechanical behavior of carbon nanotube (CNT) fibers, *e.g.*, tensile strength, strain, modulus and elastic-plastic behaviors. In this contribution, we uncover the twist-induced plastic deformation and failure behaviors of CNT fibers shrunk by ethanol (E-CNT fiber) and polyvinyl alcohol (P-CNT) solutions under low strain rate of 0.001 s^{-1} and high strain rate of 1300 s^{-1}, which are essentially important for designing high-performance composites with respect to long term stability and short-term collision, respectively. It is found that the strain-induced microstructural evolution processes of CNT fibers depends on twist angle as a result of the strengthening effect of inter-CNT friction and the weakening effect of CNT obliquity. The tensile strength, failure strain and modulus of CNT fibers are more sensitive to strain rate as the twist angle increases. The optimum twist angle provides not only the higher tensile strength, but also the better data