Theoretical models on the fracture strengths of ceramic single crystal fibers at different temperatures and test rates

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Abstract

In this paper, the new physics-based strength models for ceramic single crystal fibers at different temperatures and test rates are presented. The models provide the quantitative relation between fiber strength, temperature, temperature-dependent fiber modulus, fiber heat capacity, fiber melting point, test rates, and temperature dependent fracture surface energy or free surface energy. The fracture strengths of ceramic single crystal fibers at different temperatures and test rates can be predicted by the present models. It should be noted that these parameters used in the calculations can be conveniently obtained through the experiments and material handbooks. In addition, the predicted results that there could exist a shift for the fracture surface of c-type sapphire fiber from the c-plane to the r-plane as temperature increases. The present models could be the potential methods to quantitatively estimate and analyze the temperature and test rate dependent fracture strength of ceramic single crystals fibers.

Keywords: Temperature-dependent; Ceramic single crystal fibers; Fracture strength; Slow crack growth