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The Effect of Pre-Cracks on Structural Strength of the Nextel Fibers: A Multiscale Modeling Approach

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Abstract : In this study, a multiscale framework is performed to model the strength of Nextel fibers in presence of an atomistic scale pre-crack at finite temperatures. The bridging cell method (BCM) is the multiscale technique applied in this study, which decomposes the system into the atomistic, bridging and continuum domains; solves the whole system in a finite element framework; and incorporates temperature dependent calculations. Since Nextel is known to be structurally stable and retain 70% of its initial strength up to 1100°C; simulations are conducted at both of the room temperatures, 25°C, and fire temperatures, 1200°C. Two cases are modeled for a pre-crack present in either phases of alumina or mullite of the Nextel structure. The materials' response is studied with respect to deformation behavior and ultimate tensile strength. Results show different crack growth trends for the two cases, and as the temperature increases, the crack growth resistance and material's strength decrease.

Keywords : Nextel fibers, multiscale modeling, pre-crack, ultimate tensile strength
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