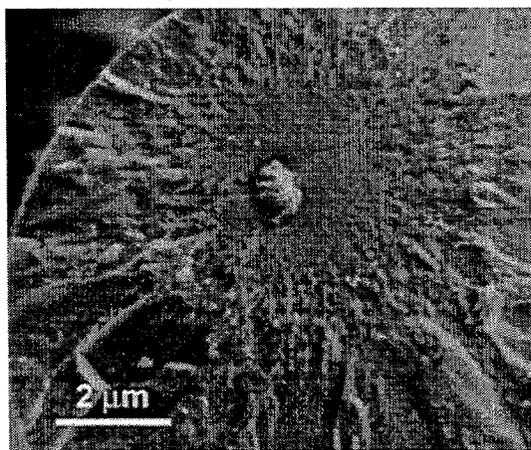
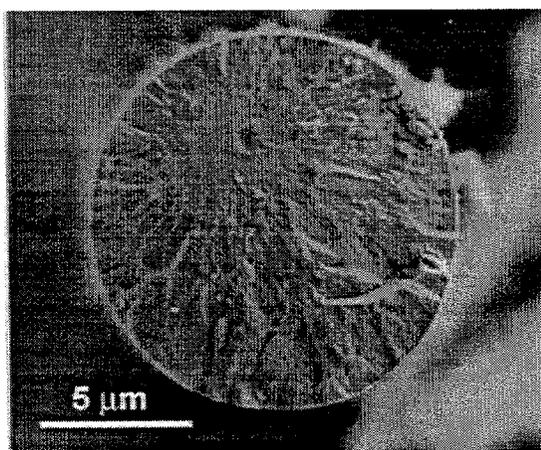


Tensile Strength and Fracture Surface Characterization of Hi-Nicalon™ SiC Fibers -
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EXTENDED ABSTRACT

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Dimensional, tensile strength and fracture surface characterizations were carried out for a particular batch (51 samples) of unirradiated Hi-Nicalon™ SiC fiber. This batch of SiC fibers is included in the radiation test matrix as part of the JUPITER 12J and 14J experiments. In general, filaments of Hi-Nicalon™ fiber with larger cross-sectional areas (equivalent diameters) had lower strengths than filaments with smaller cross-sectional areas. During tensile tests at room temperature, fracture originated at critical flaws that typically consisted of internal pores or carbonaceous inclusions. Well-demarcated mirror and hackle regions usually surrounded the critical flaws (See Fig. 1(a-b)). With a few exceptions, the critical flaw size (a_c) was linearly related to the mirror size (r_m) by $a_c \approx 0.33r_m$. From fracture mechanics principles, values for the average mirror constant (A_m) and effective fracture toughness for this batch of Hi-Nicalon™ fiber were estimated to be $2.99 \pm 0.33 \text{ MPa m}^{1/2}$ and $1.1 \pm 0.2 \text{ MPa m}^{1/2}$, respectively (See Fig. 2).



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Figure 1(a-b) An SEM of a typical pair of mating fracture surfaces showing in (a) an internal pore and the surrounding mirror and hackle regions, and in (b) the actual critical flaw was a carbonaceous inclusion that popped free from the opposite pore site during fracture. For this filament, the diameter, strength, flaw location parameter and the mirror and flaw radius values were 12.8 μm , 2.89 GPa, 0.44, 1.34 μm and 0.61 μm , respectively.

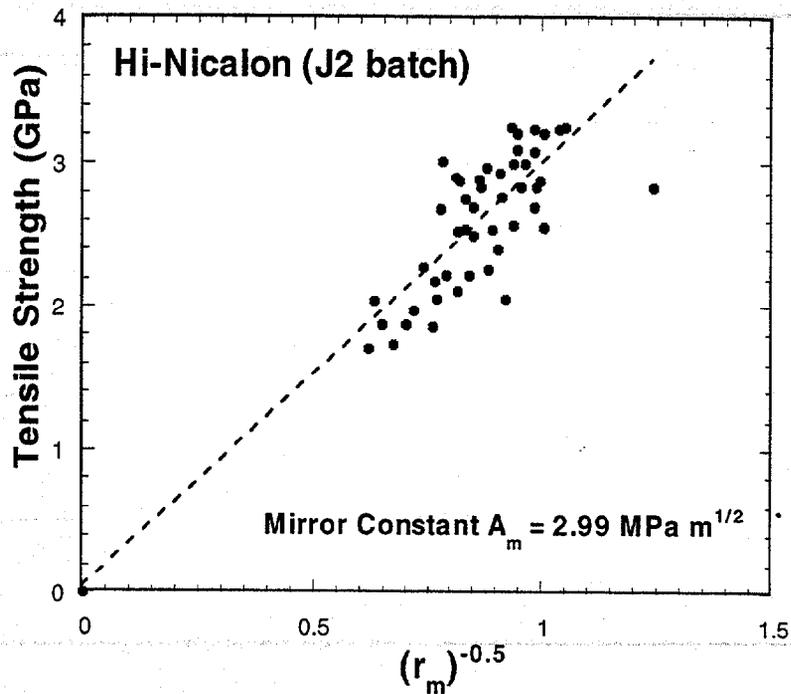


Figure 2. The fiber tensile strength versus the square root of the fracture mirror radius for the Hi-Nicalon (batch J2) set of 51 fiber filaments.

FUTURE WORK

The fiber characterization protocol established by this work should be appropriate for assessing degradation in SiC fibers due to neutron irradiation.