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Ultra High Temperature (UHT) SiC Fiber

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The first generation of silicon carbide fiber-reinforced silicon carbide ceramic matrix composites (SiC/SiC CMC) with a temperature capability of 2200-2400^{o}F are on the verge of being introduced into the hot-section components of commercial and military gas turbine engines. But SiC/SiC CMC with higher temperature capability would be more desirable in terms of further reducing component cooling air and engine fuel burn and emissions. This task is working toward this goal by the development of a high-performance small-diameter Ultra High Temperature (UHT) SiC fiber with at least 2700^{o}F structural capability, reduced cost, and improved shape-ability in comparison to current state-of-the-art SiC fibers with only ~2500^{o}F capability. Starting with low-performance commercial SiC fibers that are available at ~10% the cost of the best SiC fibers, Phase 1 efforts are demonstrating that these non-stoichiometric highly-impure fibers in multi-fiber tow form can be thermally treated in selected gaseous environments that remove the impurities while at the same time allowing the remaining porous SiC fiber to be sintered into a strong stoichiometric high-performance fiber. The sintering conditions for the UHT fiber are being down-selected to optimize its grain size, grain size distribution across the fiber cross-section, and composition at its grain boundaries, all of which control high-temperature structural capability. Another advantage of starting with low-cost precursor fibers is that prior to their conversion they can be more easily shaped than the best SiC fibers due to their much lower stiffness. Thus the down-selected treatment conditions are also being applied to textile-formed fiber preforms to demonstrate that the UHT fiber processes cannot only yield higher performing, but also more complex-shaped CMC components than those available with stiff tows of the best current SiC fibers. Progress in all these areas will be presented.