

HYPERBARIC PRESSURE – LASER ASSISTED CHEMICAL VAPOR DEPOSITION OF CERAMIC SI-BASED FIBERS

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A method of growing ceramic fibers for CMC's directly from the gas phase, called hyperbaric pressure laser-assisted chemical vapor deposition (HP-LCVD), has been investigated using SiC as a case study. In this process, a laser is focused onto a substrate whereupon the gas precursor decomposes under the focal point into its constituent species. Those species are deposited as a solid onto a substrate, nucleating a fiber which continues to grow parallel to the beam as the laser focus is withdrawn from the surface. This unique processing technique can be used to grow many fibers simultaneously using an array of beams as well as three-dimensional shapes by changing the orientation of the laser beam with respect to the tip. Depending on system pressure, laser energy, and tip retraction speed from the laser's focus, a range of fiber diameters, surface morphologies, stable or meta-stable phases, and micro/nano-structures can be achieved. These features have been assembled into a process-structure map for SiC fabrication by this method. To gain further insights into the variables that drive the thermodynamics of nucleation and growth, an in situ two-color pyrometry technique has been employed to measure the temperature in the reaction zone during the fiber's growth.

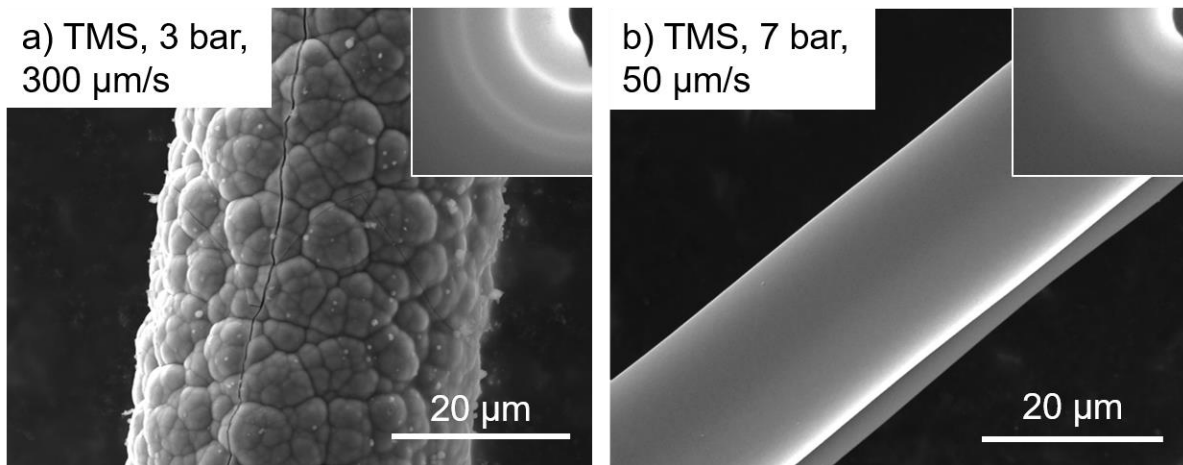


Figure 1: Two SiC fibers grown from tetramethylsilane (TMS) at 3 bar and a) 50 $\mu\text{m/s}$ and b) $\mu\text{m/s}$