Compatibility of Interfaces and Fibers for SiC-Composites in Fusion Environments

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The use of $\beta$-SiC composites in fusion environments is predicated on their stability under neutron irradiation, on their outstanding high-temperature mechanical properties, and on their chemical inertness and corrosion resistance. However, SiC is surprisingly susceptible to many forms of corrosion in water and in water vapor where silica formation is required as a protective layer because silica forms stable hydroxides that are volatile, even at low temperatures. SiC composites have an additional concern that finegrained fibers and weak interfaces provide the required fracture toughness, but these composite components may also have their own susceptibility to corrosion that can compromise material properties. In this work we examine and review the compatibility of fibers and interfaces, as well as the $\beta$-SiC matrix, in proposed fusion environments including first wall, tritium breeding, and blanket modules and module coolants. A dynamic fiber-bridging model that includes corrosion kinetics is used to explore the issues of corrosion rates, corrosion products, and fiber orientation effects on timedependent strength in order to assess compatibility of this important class of materials. The need for protective coatings for SiC-composite materials will be discussed as well as the addition of corrosion retardants to the fibers and interfaces.

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