EVALUATION OF NEUTRON IRRADIATED NEAR-STOICHIOMETRIC SILICON CARBIDE FIBER COMPOSITES – L. L. Snead (Oak Ridge National Laboratory), Y. Katoh and A. Kohyama (Kyoto University), and J. L. Bailey, N. L. Vaughn, and R. A. Lowden (ORNL)

Extended Abstract (the full paper will be published in the Journal of Nuclear Materials as Proceedings of the Ninth International Conference on Fusion Reactor Materials, October 10-15, 1999, Colorado Springs, Colorado).

Composites have been fabricated by either isothermal or forced flow chemical vapor infiltration of silicon carbide (SiC) into SiC-based fiber preforms. Fibers were Ceramic Grade Nicalon™, High-Nicalon™, and High-Nicalon™ Type-S. These fibers cover a wide range in oxygen and excess carbon content, with the Ceramic Grade Nicalon™ being the furthest from purity and the Type-S fiber being >99% stoichiometric SiC. Results are presented for two parallel studies on the effects of neutron irradiation on these materials. In the first study, neutron irradiation-induced changes in mechanical properties, as measured by bend testing, for High-Nicalon™ fiber materials of varied interphase structures are measured. The three interphases chosen were pyrolytic carbon, pseudo porous SiC, and multilayer SiC. In the second study, the mechanical properties of composites fabricated from all three fiber types are measured. For these composites, a pyrolytic carbon interphase was selected. Results indicate that both the Ceramic Grade Nicalon™ and High Nicalon™ materials degrade substantially under irradiation, though the higher oxygen content Ceramic Grade fiber degrades more rapidly and more substantially. Of the three interfaces studied in the High Nicalon™ system, the multilayer SiC is the most radiation resistant. At a dose of ~1 dpa, the mechanical property degradation of the High Nicalon™ composite is consistent with a fiber densification-induced debonding. At a dose of 10 dpa, the properties continue to degrade, raiding the question of degradation in the CVD SiC matrix as well. Low dose results on the High Nicalon™ Type-S fabricated materials are encouraging, as they appear to not lose, and perhaps slightly increase, in ultimate bend strength. This result is consistent with the supposition that as the oxygen content in SiC-based fibers is reduced, the irradiation stability, and hence, composite performance under irradiation will improve.