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Fabrication and ion-irradiation response of SiC_f/SiC with different sintering additives for nuclear reactor applications

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SiC_f/SiC for the structural components of Gen-IV fission and future fusion reactors has attracted considerable interest due to their excellent mechanical and thermal properties along with impressive post-irradiation response. Various fabrication routes (CVI, PIP, RS etc.) have already been reported with simultaneous ongoing efforts to develop newer routes that can yield improved properties. We report here a hybrid processing technique based on Electrophoretic Deposition (EPD) or vacuum infiltration as matrix infiltration route and subsequent hot pressing to fabricate dense and tough SiC_f/SiC. The adaptability of EPD process to fabricate tubular and planar SiC_f/SiC of varying sizes with tailorable properties has been demonstrated. Careful optimization of material-attributes, such as slurry composition, type and amount of sintering additives, pre-coated SiC fabric with PyC or dual PyC-SiC interphase and processing-attributes for e.g., AC-/DC-EPD, temperature and pressure variations etc., were performed. Addition of Al_2O_3-Y_2O_3, Al_2O_3-Sc_2O_3, and Sc-nitrate additives to facilitate liquid phase sintering in a processing window of 1650/1750 °C and 10/20 MPa were attempted to obtain high densities (> 95% $_{\rho theo}$) and flexural strengths (450-500 MPa) with non-brittle and predictable flexural behavior. Subsequently, room temperature irradiation of SiC_f/SiC under 0.2 MeV H^+ ions at a fluence level of 3×10^{20} ions/m^2 was conducted. Comparative microstructural assessment of matrix, fabric and interfacial regions were undertaken to explain the observed flexural behavior of SiC_f/SiC with different additives. Subsequently, post-irradiation evolution of microstructural features, such as matrix grain size, pores, cracks, surface roughness and corresponding flexural responses were recorded and contrasted.

Biography

Pipit Fitriani is currently a PhD student at School of Materials Science and Engineering, Yeungnam University, Republic of Korea. she is currently working on fabrication of SiC_f/SiC composites for structural nuclear reactor applications and has published 6 papers related to SiC.

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