RADIATION INDUCED ELECTRICAL AND MICROSTRUCTURAL DEGRADATION AT HIGH TEMPERATURE FOR HP SiC

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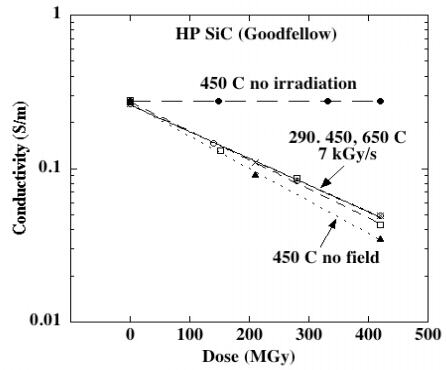
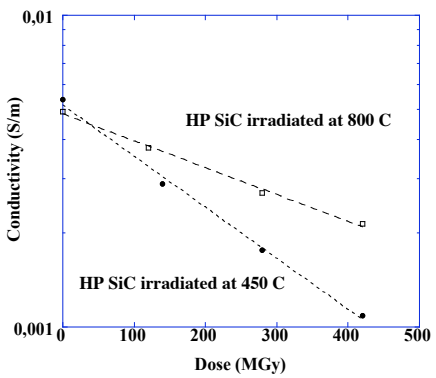
SiC based composites are candidate materials for possible use as structural materials, and also flow channel inserts in Li-Pb tritium breeding blanket modules in DEMO and future fusion reactors. Despite understanding of basic radiation damage processes and microstructural evolution having shown significant advances [1], work is still required to fully understand the mechanisms and irradiation effects. Electrical conductivity is one of the main physical properties of interest for this material for fusion applications. Previous work showed noticeable changes in electrical conductivity (Fig. 1), and also amorphization even after 1.8 MeV electron irradiation at moderate temperature (≤ 650 C) [2]. However, the material will be used at higher temperatures (≈ 800 to 1000 C). Hence studies on radiation induced degradation must be extended to cover this temperature range. The main aim of this work is to assess the radiation induced electrical and microstructural degradation for hot pressed (HP) SiC irradiated at high temperatures. Samples of HP SiC were 1.8 MeV electron irradiated at temperatures between 450 and 900 C in a Van de Graaff electron accelerator. The bulk electrical conductivity was measured at different temperatures and as a function of the irradiation dose. Following irradiation both the microstructure and the crystallinity of the material was studied. The degradation / modification of the material is lower for the higher irradiation temperature (Fig. 2) indicating that above about 800 C the induced damage may be partly annealed during irradiation.



1. Electrical conductivity at 25 C for 1.8 MeV electron irradiated SiC between 290 and 650 C. [3]



2. Electrical conductivity at 25 C for 1.8 MeV electron irradiated SiC at 450 and 800 C..

[1] Y. Katoh, L.L. Snead, C.H. Henager Tr., A. Hasegawa, A. Kohyama, B. Riccardi, H. Hegeman, Current status and critical issues for development of SiC composites for fusion applications, J. Nucl. Mater 367-370 (2007) 659-671

[2] A. Moroño, R. Vila, T. Hernández, J. Manzano and E.R. Hodgson, BA Materials activities, Fusion Eng. Des. 84 (2009) 1357-1360.

[3] E. R. Hodgson, M. Malo, J. Manzano, A. Moroño and T. Hernández. Radiation induced modification of electrical conductivity for three types of SiC. J. Nucl. Mater., to be published.