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Investigations on neutron irradiated 3D carbon fibre reinforced carbon composite material

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ABSTRACT

As against conventional graphite materials carbon-carbon (C/C) composite materials are now being contemplated as the promising candidate materials for the high temperature and fusion reactor owing to their high thermal conductivity and high thermal resistance, better mechanical/ thermal properties and irradiation stability properties. The current need is for focused research on novel carbon materials for future new generation nuclear reactors. The advantage of carbon-carbon composite is that the microstructure and the properties can be tailor made. The present study encompasses the irradiation of 3D carbon composite prepared by reinforcement using PAN carbon fibers for nuclear application.

The carbon fiber reinforced composite was subjected to neutron irradiation in the research reactor DHRUVA. The irradiated samples were characterized by Differential Scanning Calorimetry (DSC), small angle neutron scattering (SANS), XRD and Raman spectroscopy. The DSC scans were taken in argon atmosphere under a linear heating program. The spectrum was compared with that of irradiated graphite reflector of CIRUS reactor. The scanning was carried out at temperature range from 30°C to 700°C at different heating rates in argon atmosphere along with reference as unirradiated carbon composite. The Wigner energy spectrum of irradiated composite showed two peaks corresponding to 200°C and 600°C. The stored energy data for the samples were in the range 110 to 170 J/g from 30°C to 700°C. The Wigner energy spectrum of irradiated carbon composite did not indicate spontaneous temperature rise during thermal annealing. Small angle neutron scattering (SANS) experiments have been carried out to investigate neutron irradiation induced changes in porosity of the composite