Seminar

Institute for Plasma Research

Title : Radiation damage in fusion reactor materials (DI BSCCO superconducting tape and Beryllium)

Speaker: Dr. Mayank Rajput
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Date : 25th June 2021 (Friday)

Time : 03:30 PM

Venue : Online - Join the talk:
https://meet.ipr.res.in/Mayank.Postdoc

Abstract :

Energetic particles such as neutrons, ions produce interstitials and vacancies in the structural materials of nuclear reactors and particle accelerator facilities. This production of Frenkel pairs (interstitials and vacancies) affects the engineering properties of structural materials. In the present work, I have been investigating the radiation-induced effects in the fusion reactor materials primarily DI-BSCCO superconducting tape and Beryllium. I irradiated the DI-BSCCO superconducting tapes with the 100 keV deuterium ions to investigate the effect of ion irradiation on their critical current carrying capacity (Ic). The damage formation simulations are carried out using the binary collision approximation method to get the spatial distribution and depth profile of the damage events in the HTS tape. The point defects are formed near the surface of the HTS tape. These point defects distort the vortex profile in the superconducting tape. Due to the long-range interaction of vortices with each other and the depinning of the vortices throughout the tape, the critical current capacity of the tape degrades. The radiation dose of 2.90 MGy degrades the 44% critical current capacity of the tape. The results of the dpa and dose deposited by the deuterium ions are used to derive an empirical relation to predict the degradation of the critical current of the tape. This empirical relation successfully confirms the enhancement and degradation of the Ic due to the heavy and light ion irradiation on the DI-BSCCO tape, respectively. It is observed in the simulations that the same fluence of 14.1 MeV neutrons and 100 keV deuterium ions produce a similar order of dpa and dose in the HTS samples. This empirical relation can also be used in neutron and heavy ions irradiation and can be used to predict the lifetime of superconducting DI-BSCCO tape in fusion reactors and accelerator applications. Parallel to this activity, the molecular dynamics simulations of displacement damage in beryllium are also being carried out to study the effect of single and multiple recoils on the time evaluation of Frenkel pairs, kinetic and potential energy of the atoms involved in the damage cascade. The results of these studies will be presented and discussed in the talk.