Seminar

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Institute for Plasma Research

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Title : Studies on Energetic Particles and Consequences for Next Step Reactors

Speaker: Dr. P. N. Maya
Institute for Plasma Research, Gandhinagar

Date : 4th June 2021 (Friday)

Time : 11:30 AM

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

Abstract

With the advancements in high-temperature superconducting materials and novel divertor concepts, there is a strong possibility that spherical tokamaks (ST) will compete for becoming the basis of the fusion power reactor. The USP of ST is its small size and hopefully smaller cost, but this presents a formidable challenge – that of high-power density, flux, heat loads and neutron loads. Furthermore, the ratio of Larmor radius of alpha to that of minor radius is *not* significantly low and hence it is credible to speculate that although ST may have high plasma current, the alpha confinement may still be poor, leading to a new regime of plasma-wall interactions, i.e., energetic particle interaction with the plasma-facing components. There would be other challenges as well, but in the first part of this talk I focus on what can one expect when energetic particles bombard the plasma facing components. In this context, we have carried out 3 MeV helium ion irradiation in tungsten and the associated defects were studied using positron annihilation and secondary ion mass spectroscopy. The results elucidate the fundamental differences in the defect structure formation in both high and low energy helium irradiation and its potential implications in extrapolating from the ion-irradiation data to neutron irradiation scenarios relevant for reactor regimes. The experiments with helium and deuterium ions have conclusively shown the role of defect/impurity aided diffusion of gas in the metals and its impact on the formation of surface features that could lead to an un-controlled erosion of plasma-facing material which will enhance the impurity content of the plasma. This becomes especially important for ST, as we show the role of impurity radiation from the plasma core on the design constraints. In the second part of the talk, I shall discuss the modelling of low temperature deuterium plasma and its potential application in the ion beam driven plasma formation. The sensitive dependence of molecular D-ion-species composition on electron distribution functions will also be pointed out, with a significant implication on beam-species/ energy-per-nucleon.