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Neutron Irradiation Impact on ITER Grade Insulating Material

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Neutron Irradiation impact on ITER grade insulating material

Sejal Shah1,4a, Sunil Kumar2, Sudhirsinh Vala2,4, R. Kumar2, M. Abhangi2, S. Prasad3, M. Bandyopadhyay1,4, A. Chakraborty1

1. ITER-India, Institute for Plasma Research, Bhat, Gandhinagar- 382428, India
2. Institute for Plasma Research, Bhat, Gandhinagar-382428, India
3. FCIPT Division, Institute for Plasma Research, Bhat, Gandhinagar-382428, India
4. Homi Bhabha National Institute, Anushakti Nagar, Mumbai 400094, India

a.email: sshah@iter-india.org

Study is performed to assess the irradiation impact on ITER grade ceramic which is widely being used for high voltage insulation in neutral beam injectors of ITER.
Production proof samples of required sizes of high purity alumina were prepared and ultrasonically cleaned and are irradiated by two neutron sources. In-situ and ex-situ characterizations were performed to study irradiation impact on material properties and to ensure its structural and electrical compatibility.
Insulation Resistance was observed to improve with time from 250 G ohm to 3.3 T ohm and leakage current was in correlation with Curie-von Schveindler law. However, spontaneous reduction of IR at the time of irradiation was observed which was due to radiation induced conductivity. Further, the impact of irradiation on the structure was studied by X-ray diffraction analysis. The result reveals decrease in crystalline behavior after irradiation. Surface morphology of pristine and irradiated samples was studied by Scanning Electron Microscopy and Atomic force microscopy. SEM of low energy neutron irradiated sample showed defect cluster formation on ceramic surface which was also cross-checked by increased surface roughness post irradiation by AFM.
It is observed that surface morphology is getting affected mainly due to low energy neutrons whereas electrical and structural properties getting affected by high energy neutrons. To understand material performance for similar conditions of operational reactor, the study is initiated to create neutron equivalent defects in the material using ion beams and see the changes in material properties. This study will help in defining material grade for fusion based applications. Analytical assessment of nuclear activation along with experimental outcome shall be presented.

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Primary author: Dr SHAH, Sejal (ITER-India, Institute for Plasma Research, Bhat, Gandhinagar, India)

Co-authors: CHAKRABORTY, Arun Kumar (ITER-India, Institute for Plasma Research); Mr ABHANGI, M (IPR); Dr MAINAK BANDYOPADHYAY, MAINAK (ITER-INDIA, INSTITUTE FOR PLASMA RESEARCH); Mr KUMAR, R (IPR); Mr PRASAD, S. (IPR); Mr VALA, SUDHIRSINH (INSTIUTE FOR PLASMA RESEARCH); Dr KUMAR, Sunil (IPR)

Presenter: Dr SHAH, Sejal (ITER-India, Institute for Plasma Research, Bhat, Gandhinagar, India)

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