Contribution ID: **229** Type: **Poster presentation**

Radiation damage tests of diamond and scintillation detector components for the ITER Radial Neutron Camera

Wednesday 20 September 2017 10:39 (1 minute)

Radiation damage tests of diamond and scintillation detector components for the ITER Radial Neutron Camera

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During the ITER reactor operation time, the plasma will give rise to high energy neutron and gamma flux and this intense radiation field will result in serious radiation damage and activation effects on various detectors components.
In this work, neutron detector candidates for the ITER Radial Neutron Camera, i.e. diamonds and scintillator components (crystal and plastic scintillators, optical windows and PMTs), were investigated to establish their radiation hardness and stability under gamma ray and neutron irradiation.
Gamma radiation test were carried out at Calliope 60Co ENEA Plant in Rome. The facility is a pool-type irradiation plant equipped with a 60Co source (energy=1.25 MeV) with a current activity of 1.36 1014 Bq. Gamma radiation test were performed in the dark at room temperature for different total dose according to F4E requirements. Scintillators, PMTs and optical windows samples were irradiated up to ☒100 kGy absorbed dose while synthetic diamond samples up to ☒5 MGy.
Scintillators and optical windows transmittance measurements were performed in the UV-VIS range (300-700 nm), paying particular attention to the behavior at 390 and 420 nm (scintillating emission wavelengths); samples were measured in the dark before and after irradiation and performance were monitored at room temperature for some weeks in order to study the damage recovery. For plastic scintillators photo-luminescence, optical bleaching and thermal annealing processes in air were made to reduce radiation damage. Quantum efficiency measurements were performed on the PMTs and the pulse height spectra and pulse shape capability of the scintillators were investigated by using gamma and neutron sources.

Has accepted

YES

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Session Classification: Poster Session 2

Track Classification: Defect and radiation damage