Contribution ID : **51** Type : **Oral Presentation**

Ion irradiation used as surrogate for neutron irradiation to understand nuclear graphite evolution during reactor operation: consequences for the long lived radionuclide's behavior

Tuesday, 31 October 2017 16:45 (15)

Graphite has been widely used in different types of reactors such as gas or water cooled reactors. Disposal of the irradiated graphite waste is a current management strategy for the resulting graphite waste for which two main radionuclides, 14C and 36Cl, might be dose determining at the outlet. In order to simulate both ballistic and electronic effects induced by irradiation, model and nuclear graphite samples implanted with 37Cl or 14C (to simulate the radionuclides) have been irradiated using ions by varying the Sn(nuclear)/Se(electronic) stopping power ratio. Extrapolating to reactor irradiation, we show that depending on the initial graphite ordering level and texture (binder/grain) and according to the subsequent neutron flux and temperature, graphite irradiation results into a structural "zoning" impacting the radionuclide behavior: except when located close to open pores, 14C is stabilized into graphite whereas 36Cl's release is strongly correlated to the counteracting effects of irradiation and temperature.

Summary

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Session Classification : Radiation Damage

Track Classification : National and international collaborative waste management programs