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

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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, ^{14}C and ^{36}Cl , 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 ^{37}Cl or ^{14}C (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, ^{14}C is stabilized into graphite whereas ^{36}Cl 's release is strongly correlated to the counteracting effects of irradiation and temperature.

Summary

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