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## **Irradiation effects in nuclear materials: case study of nuclear fuels**

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Nuclear materials define a class of solid of interest for the nuclear industry with the specificity of being submitted to intense irradiation fields. Nuclear fuels and transmutation matrices deserve special attention due to their location at the core of the reactor, and due to the complexity of irradiation sources to which they are subjected, leading to both physical (radiation damage, atomic and electronic displacements, structural transformations) and chemical modifications (incorporation of new elements with their own chemistry in the solid matrix fuel). Ion beams delivered by accelerator facilities are unique tools to simulate the behavior of irradiated solids due to their flexibility: the various relevant parameters can be monitored selectively (e.g., ion, energy, fluence, flux, irradiation temperature) in single or (sometimes) in dual beam conditions. In particular, swift heavy ions delivered by the GANIL facility are invaluable probes to examine extreme irradiation condition provided by electronic stopping power, giving clues to extrapolate the fuel behavior for future nuclear reactors. Selected examples of irradiation condition for nuclear fuels and transmutation matrices and their consequences for their structural evolution upon ion bombardment will be discussed.

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