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Structural modifications induced by swift heavy ions in Al2O3

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Defects in oxide materials created by irradiation are often revealed by optical absorption for the formation of colour centres and by transmission electron microscopy (TEM) for the individual latent track and microstructure evolution observations. The characterizations by X-Ray diffraction of irradiated materials were lesser used but are since few years under investigation going with the development of versatile laboratory diffractometers allowing good resolution and grazing geometry (GIXRD) required to probe the upper irradiated part of samples.
In this work a detailed study on the structural modifications of Al2O3 compound induced by swift heavy ion irradiation is presented by an original combination of the three techniques, previously mentioned, in-situ GIXRD, TEM and in-situ UV-Vis absorption. The irradiation experiments have been performed at IRRSUD beamline of GANIL where the energy range, i.e. 0.3-1 MeV/A, implies a mean projected range in solid matter around only a few micrometers and a decrease with depth of the electronic stopping power (Se). Depth profile by GIXRD is thus topical to get structural parameters at different Se values.
In the communication the study of alpha-Al2O3 polycrystals and single crystals irradiated by 92 MeV Xe and 74 MeV Kr will be shown. Contributions from point defects and extended defects induced by irradiation to structural modifications will be discussed. An amorphization of the material is observed and its kinetics of ion track overlapping will be shown. This amorphization is associated in the crystalline part to tensile strain, unit cell swelling, microstrain, grain subdivision and a variable damaging sensitivity of the anionic and cationic sublattices. Our results are consistent with the previous reports found in literature and are in agreement with the given Se threshold for amorphization. These results will be fully described and illustrated during the communication.

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