Contribution ID: **548**

Type: **not specified**

P4.213 Ion irradiation in oxide nanoceramics: on the role of the irradiation spectrum at extreme damage levels

Thursday, 20 September 2018 11:00 (2 hours)

In the framework of future generation nuclear reactors, structural materials will face environmental conditions even more challenging with the highest radiation damage levels. To deal with this, oxide nanoceramics have been proposed. Oxide nanoceramics combine the enhanced radiation tolerance of nanocrystalline materials with the chemical inertness of oxides. In this work, the properties of Al2O3 films are evaluated as radiation damage approaches extreme values, reaching and even exceeding those anticipated for advanced nuclear systems (namely from 150 to 450 displacements per atom). Irradiation tests are performed using different ions in order to investigate the effect of the irradiation spectrum on the material's evolution. A comprehensive analysis of the irradiated samples is accomplished by X-Ray Diffractometry (XRD), Transmission Electron Microscopy (TEM), Scanning-TEM (STEM) and nanoindentation. The results show a general grain growth as the main structural change induced by irradiation in oxide nanoceramics. This structural change manifests mechanically through an initial increase of hardness (in accordance with the Hall-Petch relationship) and eventually through softening in the very last part of the experiment. Stiffness increases sub-linearly with damage before reaching a plateau. Further, both hardness and stiffness depend on the phase present. A deep effort is made to establish a correlation between irradiation spectra and the evolution of the oxide's structural features and mechanical properties. The phase evolution appears to depend strongly on the ion utilized and on the irradiation spectrum, so the kinetic of the grain growth process. Finally, molecular dynamics simulations of displacement cascades are used to support the collected data and a preliminary model is formulated according to these observations. To conclude, an extensive characterization campaign is performed on nanoceramic Al2O3 in order to study its behavior at extreme radiation damage levels: structural and morphological changes are analyzed and supported by modelling.

Presenter: Dr VANAZZI, Matteo (Center for Nano Science and Technology (CNST) Istituto Italiano di Tecnologia (IIT))

Session Classification: P4