Invited-

Damage accumulation studies in irradiated oxides: current status and new perspectives

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A complete description of damage accumulation process in irradiated solids is one of the key issues of nuclear engineering. Development of predictive models of material behavior in nuclear installations requires detailed understanding of mechanisms leading to structural transformations and, consequently, changes in their functional properties. In general damage accumulation analysis involves three main aspects: (i) identification of kind of defects at various stages of damaging process, (ii) quantitative measurement of the damage level and (iii) modelization of the damage accumulation process.

Various experimental and simulation tools may be used for damage accumulation studies. The method of choice in analysis of defect structure is Transmission Electron Microscopy (TEM), whereas for quantitative analysis of damage level Rutherford Backscattering/Channeling (RBS/C) method is mainly used.

Numerous studies performed in the past allowed to collect a solid database describing the evolution of defects upon irradiation and to build models (mainly phenomenological) of damage accumulation. Current status of the results collected for irradiated oxides will be reviewed in the first part of the presentation.

Critical review of the currently available information points to the missing elements in damage accumulation approach. Among them the need for a method allowing for quantitative assessment of damage level in polycrystals and to close a gap between atomistic simulations (essentially made by using Molecular Dynamics, MD) and results of the experiments performed on irradiated materials appear as the most urgent tasks. The preliminary results of already initiated attempts to answer these needs will be presented in the second part of the talk.

The last part of the presentation will be devoted to the proposition of a more complete approach in the analysis of damage accumulation in irradiated oxides combining several experimental techniques (RBS/C, TEM, XRD) with molecular dynamic simulations and phenomenological modelling.