Symposium | B. Challenges in the Multiscale Modelling of Radiation Effects in Nuclear Materials

[SY-B7]Symposium B-7

Chair: Marjorie Bertolus(CEA/DEN/DEC, Centre CEA de Cadarache, France)
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[SY-B7]SCIANTIX: A new inert gas behaviour module ready for use

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Being able to bridge lower length-scale calculations with the engineering-scale simulations of fuel performance codes requires the development of dedicated intermediate-scale codes. In this work, we present SCIANTIX, a recently developed code which aims to fill this gap. SCIANTIX is a 0D stand-alone computer code under development at Politecnico di Milano since 2016. It is designed to be included as a module in existing fuel performance codes (e.g., TRANSURANUS). It contains models describing inert gas behaviour at the scale of a fuel grain, represented as a point (i.e., 0D). Since it is 0D, no spatial discretization is required, and all variables are treated as average in space. Nevertheless, the models available in SCIANTIX (covering intra- and inter-granular inert gas behaviour, and high burnup structure formation and evolution as well) are physics-based and not correlation-based. The main characteristic of SCIANTIX is thus the simplicity of the models (i.e., low computational burden, in line with the requirements of fuel performance codes), paired with the possibility to inform them with parameters from lower length-scale calculations. SCIANTIX is validated against hundreds of experimental data describing inert gas behaviour at the scale of fuel grains. The validation is supported by uncertainty analyses on the main model parameters. Moreover, sensitivity analyses are performed to prioritize further research activities. Showcases of validation, uncertainty and sensitivity analyses are presented in this work (e.g., concerning gas concentrations, evolution of intra- and inter-granular bubble populations, swelling, high burnup structure formation). As for the numerical treatment of the model equations, SCIANTIX is developed with full numerical consistency and entirely verified with the method of manufactured solutions (verification of different numerical solvers is also showcased in this work). The open source release of the code is planned soon.

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