HIGH CHROMIUM STEELS ASSESSMENT: EXPERIMENTAL AND MODELLING

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High-Cr ferritic/martensitic steels are being considered as structural materials for a number of future nuclear applications, from fusion to fission accelerator-driven systems and GenIV reactors. Hence, understanding of the basic mechanisms governing the behaviour of these steels under harsh neutron irradiation conditions is of essential importance for pragmatic development of radiation-resistant materials. A number of irradiation experiments were performed at SCK•CEN to assess the performance of high-Cr steels. The construction of a whole modelling framework was required to provide indicative interpretation of the experimental findings on the ductile-to-brittle transition temperature, void swelling and hardening induced by irradiation. This involved application of *ab initio* techniques, development of a new formalism for interatomic potentials, setting up novel modelling tools utilizing artificial intelligence, in addition to classical molecular dynamics and Monte Carlo methods. With these, primary damage, defect migration, dislocation-defect interaction, phase separation was studied using entirely atomistic self-consisted approach. In the presentation, an overview of the effort made at SCK∙CEN, from both the experimental point of view and to model radiation damage in Fe-Cr alloys, is given, highlighting results that provide a key for interpretation of existing experimental results.