

Toward an integrative Approach of Nuclear Glass alteration in a Reactive environment from MultiscAle Modelling

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In France high level wastes generated by spent nuclear fuel reprocessing are immobilized in a glassy matrix by a vitrification process. The glass waste packages are intended to be disposed in a deep geological repository (DGR), providing a passive and safe management solution to isolate the radionuclides (RN) from the biosphere. Glassy matrix is the first barrier designed to confine the RN by establishing chemical bonds between RN and the glass network formers. Understanding the ageing of the glassy matrix toward the various thermal, mechanical, chemical and radiological stresses encountered under geological disposal is therefore crucial to be able to build long term behavior model that support performance and safety assessment of DGR.

In recent years a new approach was designed to develop the future scientific reference long term behavior model for nuclear glass with respect to French's DGR concept. This coordinated research program called TANGRAM - Toward an integrative Approach of Nuclear Glass alteration in a Reactive environment from MultiscAle Modelling, is being carried out by several CEA laboratories in collaboration with key players in the French nuclear industry (Orano, EDF) and waste management organization (Andra).

It follows the classical methodology of long-term behavior science based on the combination of experimental and modelling studies. A multiscale modeling approach (Molecular Dynamic, Monte-Carlo, Phase field) has been developed to improve the atomistic and mesoscopic understanding of nuclear glass ageing. The objective is to use the atomistic and mesoscopic models to test and improve the macroscopic model (GRAAL2), itself based on geochemical modelling, which will in turn be applied to the assessment of performance in vitrified waste cells. The application domain and predictive capacity of the macroscopic model will be tested and gradually validated using experiments of increasing complexity.

The current presentation will expose the TANGRAM program and progress status.