



Alpha radiolysis impact on magnesium alloy corrosion in model alkaline solutions

**Benoist MUZEAU¹, Eric SCMUCKER², Aurélien CANIZARÈS³, Patrick SIMON³,
Nicole RAIMBOUX³, Dominique BAUX³, Thierry SAUVAGE³**

¹ *Den-Service d'Etude du Comportement des Radionucléides (SECR), CEA, Université Paris-Saclay, F-91191, Gif-sur-Yvette, France*

² *Den-Service de Corrosion et d'étude du Comportement des Matériaux dans leur Environnement (SCCME), CEA, Université Paris-Saclay, F-91191, Gif-sur-Yvette, France*

³ *CEMHTI - UPR3079 CNRS, 1D avenue de la Recherche Scientifique, F-45071 Orléans Cedex 2, France*

The reprocessing of spent nuclear fuel from the French UNGG reactors (Natural Uranium Graphite Gas) requires the conditioning of the magnesium alloys used as cladding material of the fuel assemblies. Packaging of these metallic wastes in a cement matrix requires to study the corrosion of Mg alloys in these highly alkaline media (pH>12.5). Once irradiated in reactors, the Mg claddings are activated and potentially contaminated and therefore present a mixed abg radiological spectrum. The radiolysis of the pore solution of the cement matrices (alkaline solution contained in the cement porosity) could then modify the corrosion mechanisms of these magnesium alloys.

The purpose of this work is to investigate the impact of the alpha radiolysis at the metal/solution interface through electrochemical measurements on Mg targets, under irradiation. To ensure these measurements, a metal/solution interface irradiation cell has been defined. The irradiation of the Mg/solution interface reproduce the alpha radiolysis induced in the pore solution of a cement matrix by the actinides. During irradiation, measurements of potentials and currents could be carried out in situ, enabling a direct assessment of the impact of alpha radiolysis on the metal corrosion. Post-mortem Characterizations have been performed on the irradiated Mg targets.

We have already evidenced a relationship between Mg-0.5%Zr corrosion rate and the alpha flux in the synthetic pore solution of a geopolymer binder. Nevertheless, the composition of the pore solution is complex and it is difficult to determine the influence of each constituent on the corrosion rate. Thus comprehension experiments were conducted in irradiating Mg/solution interfaces with model solutions to test independently the effect of pH, or ions e.g. silicate. They revealed the leading parameters influencing Mg/solution corrosion under alpha radiolysis.

Work performed within the Investments for the Future Program of the French Government and operated by the French National Radioactive Waste Management Agency (Andra).

Keywords: Magnesium; irradiation; alkaline; interface; geopolymer.

Corresponding author: