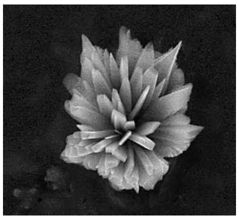
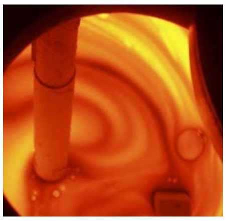
NUCLEAR ENERGY AND WASTE VITRIFICATION

Sophie Schuller, Emilien Sauvage, Kolani Paraiso
Enrichment, Decommissioning and Waste research department
CEA/DES/ISEC/DE2D
F-30207 Bagnols-sur-Cèze, France
sophie.schuller@cea.fr

Abstract

Vitrification of high-level liquid waste is the internationally recognized standard to minimize both the environmental impact resulting from waste disposal and the volume of conditioned waste. In France, high-level liquid waste arising from nuclear fuel reprocessing has been successfully vitrified for more than 50 years with three major objectives: durable containment of the long-lived fission products, minimization of the final waste volume, and suitability for an industrial framework. As a result, the Science and Technology Institute for Circular Economy of Low Carbon Energies (CEA-ISEC) has developed a unique level of experience in the field of high level waste vitrification through the design and operation of facilities with very good safety, reliability and product quality. On-going parallel efforts focus on improving the technology (from hot to cold crucible melter) and the associated matrix formulations, with constant emphasis on quality and volume reduction.

Highly focused research programs are still underway in CEA/ISEC/DE2D in the Enrichment, Decommissioning and Waste research department. The main issues facing us today are to accommodate new types of waste and higher waste loading, while enhancing the glass quality and increasing the production capacity and robustness of plants. This requires extensive knowledge on nuclear vitrification processes, technologies and physical-chemistry of vitreous materials. Basic research supported by a modelling approach is conducted from laboratory-scale and mock-up, to full-scale non-radioactive facilities.

This talk will be focus on academic research conducted to understand the phenomenology behind the formation of the nuclear glass and glass-ceramic and its evolution after cooling from atomic to macroscopic scale.

Following a general introduction on nuclear wastes and French nuclear glass waste forms, we will focus on studies help to better explained and control the mechanisms of chemical reactivity between the glass precursors, crystallization, phase separation and diffusion during nuclear glass synthesis. In this presentation we will focus both on experimental and modeling 0D (glass melting model) and 3D approaches solved with CFD tools.