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► To cite this version:

Sophie Schuller, E. Sauvage, Z. Naby, R. Podor, E. Régner, et al.. Advancements in nuclear waste vitrification: a multifaceted modelling approach. GLOBAL 2024, Oct 2024, Tokyo, Japan. cea-04651387

HAL Id: cea-04651387

<https://cea.hal.science/cea-04651387>

Submitted on 17 Jul 2024

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Advancements in Nuclear Waste Vitrification: A Multifaceted Modelling Approach

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Highly focused research programs on nuclear waste vitrification are still underway in the “Science and Technology Institute for Circular Economy of Low Carbon Energies” (CEA/ISEC). The main issues facing us today are to accommodate new types of wastes and higher waste loading, while enhancing the glass quality and increasing the production capacity and robustness of plants. This requires an extensive knowledge on glass melting processes and physicochemical 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 focused on research conducted to model the glass melting process and the rheological behavior of the melt. First, a modelling approach able to couple reaction kinetics laws of thermally activated glass melting processes (denitration, crystallization, formation of intermediary compounds, dissolution, homogenization) to a magneto-thermo-hydraulic (MTH) model will be presented. Second, we will focus on the impact of crystals (noble metal, cerianite, apatite) and separated phases on glass melt rheology. At the end, we will discuss the possible coupling or chaining of the rheological behavior of the melt to the MTH model.