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Sintering of a Simulated High Level Waste in an Yttrium Aluminosilicate Glass

Diana C. Lago

Departamento Materiales Nucleares – Centro Atómico Bariloche – Comisión Nacional de Energía Atómica.

E-mail address: dlago@cab.cnea.gov.ar

Miguel O. Prado

Departamento Materiales Nucleares – Centro Atómico Bariloche – Comisión Nacional de Energía Atómica.

Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET).

E-mail address: pradom@cab.cnea.gov.ar

Abstract: Throughout half a century of nuclear activity, Argentina has produced different types of radioactive wastes that mainly remain stored at nuclear power plants sites. Most of it comes from its three nuclear power plants, which provide 10 % of the electricity to the interconnected national system.
In order to improve the glass matrices that are currently being used, we explored other glassy systems such as yttrium aluminosilicate (YAS) glasses. This proposal arises due to the chemical and mechanical durability of YAS glasses as host matrices for HLW immobilization.
In this work we experimentally evaluate the immobilization of a simulated HLW in YAS glass by sintering. A simulated high level liquid waste solution as could be obtained from a PHWR Argentinean type reactor was prepared and it was mixed with YAS glass powders to obtain a waste loading of 10 wt%. The powder was pressed in cylindrical dies and sintered. The interaction of viscous flow sintering and crystallization kinetics, which occur during heat treatment of the green samples, was evaluated by hot stage microscopy and DTA.
In order to minimize crystallization during sintering, we selected the temperature determined by DTA experiments and carried out non-isothermal experiments.
We found that it is possible to obtain a monolith of YAS glass with minimum crystallization. However when wastes are included high porosity arises due to denitration and crystallization. Main observed crystalline phases are yttrium disilicate, mullite and sillimanite and seem not to cause a degradation of the main properties. Sintered samples were characterized by EDS, XRD and SEM. Also, the chemical durability of the sintered samples was evaluated through MCC-1 test, obtaining leaching rates of the order of $1x10^{-2}$ g/m^2d, comparable or even better of those obtained with other glasses used in nuclear waste immobilization.