Mass Transfer Characteristics of Oxygen Ions Released from Uranium Oxide to a Molten Salt

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The volume and the radioactivity of spent oxide fuels discharged from commercial PWRs are reduced by a quarter when the oxygens of the irradiated uranium oxides are removed and some of the fission products are separated from the reduced metals. Recently, pyroprocess using a molten salt has been considered as a promising and economical option for treating spent fuels. Korea Atomic Energy Research Institute (KAERI) has developed a molten LiCl-based process which adopts an electrolytic reduction technology. An inert ceramic membrane filled with U_3O_8 powders acts as a cathode where the oxygens are ionized and, at the opposite side of an electrolytic cell, platinum anodes take the electrons from the oxygen ions to change them into gas. The mass transfer of the oxygen ions is of great interest for the sake of analysing the process. The mass transfer could be divided into three steps; 1) internal diffusion from the inside of a metal oxide powder to the surface, 2) external diffusion along the outside of the metal powers, and 3) mass transfer through the fine pores of the ceramic membrane. The mass transfer is investigated by an electrochemical and a simple chemical method to conclude that the internal diffusion is the rate-determining step.