

Thermal Expansion of ZrO_2 -20 mol % Gd_2O_3

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To increase the maximum fuel discharge burn-up and the period in a reactor, higher contents of fissionable materials such as U-235 and Pu-249 have been required. In this case, Gd_2O_3 is used as a burnable poison to suppress the initial excess reactivity of the core. It is used as a form of solid solution in a fuel matrix or rod type (Gd_2O_3 or Gd_2O_3 - ZrO_2) in a duplex type fuel. In comparison to the solid solution type fuel, duplex type fuel has the advantage of lower centerline temperature and fission gas release, and no degradation of thermal conductivity because it is Gd-free in the fuel matrix. However, at elevated temperature, the compressive and tensile stresses and gap variation occurred in the fuel and Gd_2O_3 (or Gd_2O_3 - ZrO_2) rod due to the different thermal expansion in each material. Gd_2O_3 - ZrO_2 system is also used as good oxide ion conductors and is being considered as a promising candidate for immobilization of plutonium for disposal. In this study, the thermal expansions of a ZrO_2 -20 mol % Gd_2O_3 rod were measured using a thermo-mechanical analyzer (TMA) in the temperature range of 293 to 1773 K. Also, the thermal expansion coefficients and density variations with temperature were calculated from the thermal expansion data. For the temperature range from 298 to 1073 K, the value of the average linear thermal expansion coefficient of the ZrO_2 -20 mol % Gd_2O_3 pellet is $9.522 \cdot 10^{-6} \text{ K}^{-1}$. The thermal expansion of ZrO_2 -20 mol % Gd_2O_3 pellet is lower than that of ZrO_2 and higher than Gd_2O_3 . As the temperature increases to 1773 K, the density of ZrO_2 -20 mol % Gd_2O_3 pellet decreases to 94.98 % of the initial density at 298 K.