7-5 Elucidating Thermal Change in Am-Containing Oxide Fuels
—Investigation of Thermodynamic Properties of Nonstoichiometric Am Oxides—

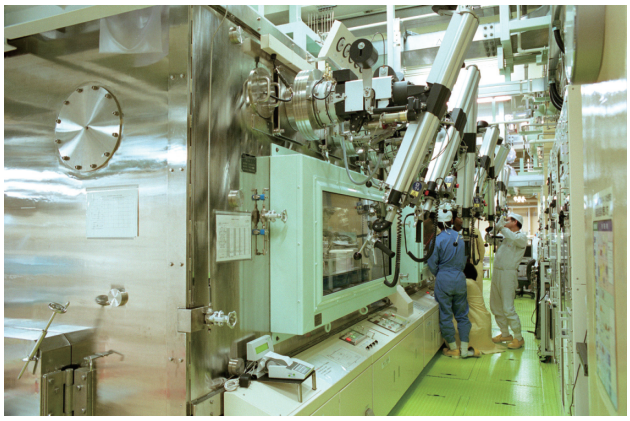

Fig.7-12 Module for TRU high temperature chemistry
The module is composed of three hot-cells and a glove-box filled with inert atmosphere.

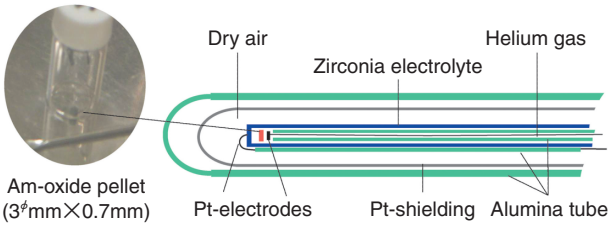

Fig.7-13 Electrochemical cell with a zirconia electrolyte
The reference gas for the cell is air. The oxygen potentials of Am oxides are calculated from the potential difference between two Pt-electrodes.

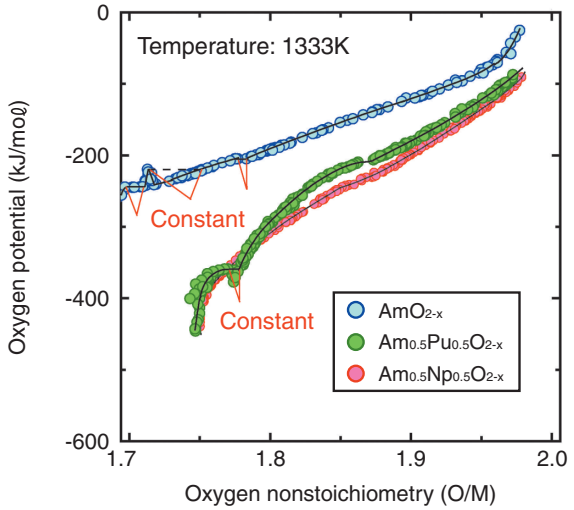

Fig.7-14 The relation between the oxygen potentials and oxygen nonstoichiometry (O/M) of Am oxides
This figure shows the comparison of the oxygen potentials of AmO_{2-x}, $Am_{0.5}Pu_{0.5}O_{2-x}$, and $Am_{0.5}Np_{0.5}O_{2-x}$ at 1333K. The oxygen potentials for each Am oxide decrease with decreasing O/M. For AmO_{2-x}, and $Am_{0.5}Pu_{0.5}O_{2-x}$, however, the oxygen potentials keep constant over some O/M ranges. This reveals that AmO_{2-x} and $Am_{0.5}Pu_{0.5}O_{2-x}$ have a mixture of phases over these O/M ranges.

For future nuclear fuel cycles, we are developing the technology of recovering minor actinides (MA: Np, Am and Cm) from spent fuels and transmuting them by fast reactors. MA recycling can reduce the long-term hazard and the area of the site needed for disposal of the high-level radioactive waste. To burn MA effectively and safely, it is necessary to develop the MA-containing oxide fuels and get a reasonable understanding of their oxygen potentials to predict their compatibility with fuel-cladding and their thermal behavior during irradiation.

Therefore, we installed a module for TRU high temperature chemistry (Fig.7-12) in NUCEF of JAEA, in order to study MA-containing fuels. We investigated the relation between the oxygen potentials and oxygen nonstoichiometry (O/M) of Am oxides by an electrochemical method (Fig.7-13). In this study, we could test a sufficiently large amount of Am, and electrochemically control O/M of the samples with sufficient accuracy to get data with good precision (Fig.7-14). We found that the thermodynamic properties of Am oxides exhibit a systematic change. This study indicates a method for prediction of the thermal behavior of Am-containing oxide fuels, enabling the evaluation of technological feasibility of MA recycling.

This study includes the results of the collaborative research program "TRU (transuranium elements) Behavior in Oxide Fuels" with Tohoku Electric Power Company, Tokyo Electric Power Company and the Japan Atomic Power Company, and the results of "Development of Common and Fundamental Technologies for Evaluation of Nuclear Fuel Behavior in MA recycling" entrusted to the Japan Atomic Energy Agency by the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT).

Reference

Otobe, H. et al., Oxygen Potential Measurement of Americium Oxide by Electromotive Force Method, Journal of the American Ceramic Society, vol.91, issue 6, 2008, p.1981-1985.