

Property estimation and integrity prediction of nuclear fuels and materials in normal and accident conditions

Property measurement of simulated fuels
Property estimation by chemical calculations
Development of measurement techniques

OUTLINE

Properties of pellets vary with burnup by FPs and metallurgical faults and Zr alloy claddings degrade by oxidation and hydrogen absorption in a reactor. Such variation of the properties are studied by experiments of simulated fuels and chemical calculations and the integrity of the fuel is estimated. Techniques for the property measurement of irradiated fuels in a hot cell are also developed.

RESEARCH WORKS

Development of techniques for thermal conductivity measurement of irradiated pellets.

Techniques to measure thermal conductivity of a whole pellet and that of the precipitates in a hot cell are developed using "hot desk method (HD)" and "thermal microscope (TM)", respectively.

HD sensor Irradiated fuels Principle of TM Annular HD sensor

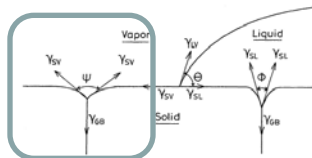
Annular sensor and analysis based on 1-D thermal conductance model made to estimate thermal conductivity of annular pellets.

Measurement of contact angles of CeO₂ grain with CsI melt

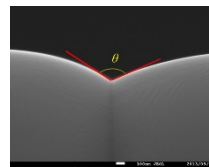
In order to establish the thermodynamic equilibrium considering excess surface and interface energies in a debris contact angles of CeO₂(UO₂) with CsI melt are measured.

$$G = G^B + G^S + G^I$$

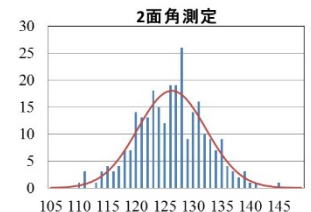
Constrained Free Energy Minimization Method



Measurement of interface energy



SEM photo of CeO₂ crystal



Measured contact angle

Reaction behavior of corium, sodium and concrete materials

To develop estimation methods for integrity of container vessel of sodium fast reactor in a severe accident condition the reaction behavior of corium, sodium and concrete materials is studied by experiments using simulated material including uranium as well as sodium tests and thermodynamic calculations.



SEM/EDXA



X-ray diffraction



Furnace for sodium compounds



DSC



Laser flash

FUTURE PERSPECTIVE

Fuel study; exp. of simulated materials, chemical calc. and exp. of actual fuel in a hot cell

Researches using Uranium and Thorium in the Lab. sometimes in collaboration with Osaka university and/or JAEA

Study on behavior during severe accidents and treatment of melted fuels

MESSAGES FOR APPLICANTS

Students who study or want to study material science are welcomed. You will test Uranium and Thorium compounds and acquire calculation chemistry. You also have an opportunity for internship at JAEA and so on using more real materials.