In-situ high Temperature X-ray Diffraction for Structural Transition of Uranium Oxide

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Introduction

- After nuclear power generation, amount of spent nuclear fuel is steadily increased, researchers have been increasingly interested in methods of disposal spent nuclear fuel.
- It is very important to structural changes according to temperature because various compounds between nuclear fuel and fission products can exist by heat generated from nuclear fuel.
- To observe the structural behavior between UO₂ and fission product in spent nuclear fuel depending on temperature using powder x-ray diffraction.
- Uranium oxide materials have been of particular interest in broad nuclear fuel fields because of the structural changes derived from various oxidation state numbers such as UO₂, U₃O₉, U₄O₉, and UO₄.
- X-ray diffraction is too difficult to measure while controlling the temperature, we can the temperature by adding a special device, and acquire the powder diffraction pattern at the controlled temperature to check the structural change in real time.

Experimental

Powder and Pellet Samples

- UO₂ powder : 30 °C → 1800 °C
- UO₂ pellet : 30 °C → 1800 °C

Results & Discussion

- UO₂ powder : PXRD patterns shifted slightly to the left shift.
- UO₂ pellet : PXRD patterns shifted slightly to the left more than the UO₂ powder at high temperature.
- The UO₂ powder and UO₂ pellet structures were observed using in-situ high temperature x-ray diffraction.
- The cell parameters were characterized by calculation methods (TOPAS).
- The controlled condition of materials were heated gradually to above 1,800°C
- The change of lattice parameters of materials crystal structures were confirmed by XRD patterns.

Conclusion

- The UO₂ powder and UO₂ pellet structures were observed using in-situ high temperature x-ray diffraction.
- The cell parameters were characterized by calculation methods (TOPAS).
- The controlled condition of materials were heated gradually to above 1,800°C
- The change of lattice parameters of materials crystal structures were confirmed by XRD patterns.

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