燃料デブリ分析のための超微量分析技術の開発 (13)アルカリ融解法を用いたウランとジルコニウムの混合比の異なる模擬デブリの酸溶解特性

Development of ultramicro analysis technology for fuel debris analysis
(13) Dissolution behaviors of simulated debris with different uranium/zirconium ratios by using alkaline fusion method

*ZhuoRan Ma[1], Hiroyuki Kazama[3], Yoshiya Homma[2], Konashi Kenji[2], Tatsuya Suzuki[1]
1. Nagaoka Univ. of Tech., 2. Tohoku Univ., 3. JAEA

Abstract:The dissolution of nuclear fuel debris generated from Fukushima nuclear power plant accident is necessary for the accurate and precise analyses of actinides and fission products. We have proposed the chemical conversion of insoluble nuclear fuel debris into soluble substances by alkaline fusion method. In the present work, the dissolution behavior in Nitric acid and Hydrochloric acid of simulated nuclear debris including UO_2-ZrO_2 by alkaline fusion reaction with Na_2O_2 were studied. The dissolution rate reached more than 99% by the weight of residue after filtration.

Keywords: Simulated Debris, Alkaline Fusion, Dissolution

1. Introduction

Fuel debris generated in severe nuclear accident (especially Fukushima Daiichi Nuclear Power Plants accident) contains nuclear fuel and core structural materials, and/or concrete materials. Thus, debris are difficult to dissolved into aqueous solutions. Analyses of actinides and several kinds of nuclides are required for planning of the effectual management of debris, and of the adequate decommissioning[1].Now we have proposed that these substitutes are chemically converted into easily soluble substitutes by thermochemical reactions. For this reason, the basic research on the powder of uranium oxide and uranium-zirconium mixture is carried out first.

2. Experiment method and results

For the simulated debris pellet with U-Zr mole ratio of 1 to 1 and sintered for 10 minutes at 1400℃, they were ground to powder and checked by XRD and SEM. The powder next mixed with Na_2O_2 with mass ratio of 1 to 10 (0.05g/0.5g). After heating at 650℃ for 1 hour, they were dissolved with 6mol/l nitric acid or 6mol/l Hydrochloric acid. After pressure filtration, weigh the dried filter paper to determine the quality of the filter residue. The U and Zr concentrations in the filtrate will be further analyzed by ICP-MS in the next study.

3. Conclusion

Although the filtrate may contain a large amount of Na complexes, high dissolution rates were achieved for both 6 mol/l nitric acid and hydrochloric acid. The dissolution rate reached more than 99% by the weight of residue after pressure filtration.

This work is financially supported by the Nuclear Energy Science & Technology and Human Resource Development Project (through concentrating wisdom) from the Japan Atomic Energy Agency / Collaborative Laboratories for Advanced Decommissioning Science.

References

[1] Washiya T., et al. Proc. 23th Inter. Conf. Nucl. Eng. p. 37

---

*ZhuoRan Ma[1], Hiroyuki Kazama[3], Yoshiya Homma[2], Konashi Kenji[2], Tatsuya Suzuki[1]
[1]Nagaoka Univ. of Tech., [2] Tohoku Univ., [3]JAEA