6 - 13 Irradiation Effect of CERCER Fuel for ADS Transmutation Using Surrogate CeO_2-MgO Pellets

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Accelerator driven subcritical system (ADS), with the advantages of high intrinsic safety, hard neutron energy spectrum, and the ability to load large amounts of minor actinides, is considered to be one of the most promising technical approaches for the transmutation of radioactive nuclear waste. One of the key issues in the research around ADS is the development of advanced nuclear fuels containing minor actinides. MgO-based dispersion fuel has been viewed as a very promising fuel candidate for ADS due to its high consumption rate of minor actinides, low manufacturing cost, high MA material loading and good compatibility with existing spent fuel post processing routes[1,2]. Cerium is often considered as a typical substitution of the actinides because of the similar physico-chemical properties, including ionic radii in octahedral and cubic coordination, melting points, standard enthalpy of formation and specific heat and chemical behavior[2]. In order to investigate the irradiation behavior of surrogate CeO_2-MgO pellets under neutron and fission products, a simulation study utilizing Xe-ion was conducted. The irradiation experiments with 5.4 MeV Xe was carried out on the 320 kV platform at IMP. The irradiation temperature was set to 800 , and the irradiation doses were in range of 5×10^{14} to 5×10^{15} ions/cm^2.

After irradiation, TEM was applied to characterize the microstructure of irradiated samples. A large number of dislocation loops was observed in the MgO grains, while no obvious damage was found in the CeO_2 grains, indicating that CeO_2 has a better resistance to irradiation than MgO (Fig. 1). Further analysis is still being conducted.

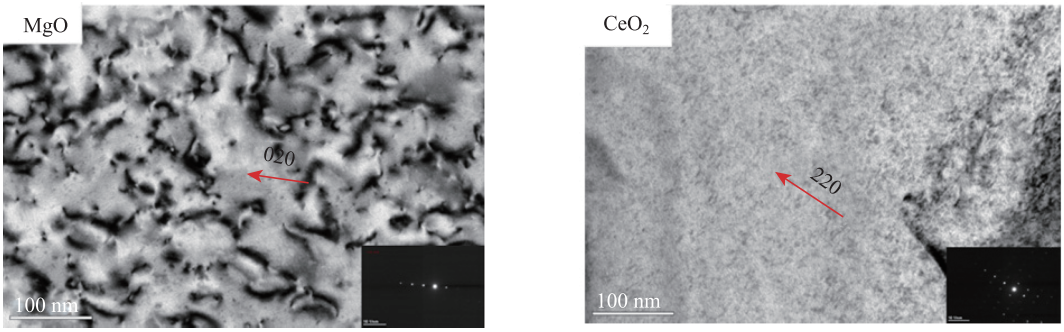

Fig. 1 (color online) The microstructure of CeO_2-MgO pellets irradiated with Xe ions to 2×10^{15} ions/cm^2.

References

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[2] E. L. Mühr-Ebert, E. Lichte, A. Bukaemskiy, et al., Journal of Nuclear Materials, 505(2018)94.