Investigation of crush load and microstructure on Li2+xTiO3+y pebbles after annealing in a reducing atmosphere

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Lithium titanate with additional Li (Li2+xTiO3+y) has been considered to be used in a DEMO blanket as an advanced tritium breeder because the Li content of Li2+xTiO3+y is higher than that of stoichiometric lithium titanate (Li2TiO3). It has been reported that the mass of Li2TiO3 decreases with time during annealing in a H2 atmosphere [1]. This mass change indicates that the oxygen content of the sample decreased, suggesting the change from Ti4+ to Ti3+. This mass decrease most likely causes some effect on the crush load of the breeder pebble, so the characterization of the pebble after long-term annealing in a H2 atmosphere is important for the blanket design.

In this study, the crush load and the microstructure of Li2TiO3 and Li2.11TiO3+y pebbles were examined after annealing in a reducing atmosphere by using a crushing test device and a scanning electron microscope (SEM), respectively. These pebbles were thermally treated at 900 oC, which is the maximum temperature in the water-cooled blanket, in Ar with 5% H2 atmosphere. In order to discuss the effect of the reduction and the thermal process during the annealing separately, heat treatment in air were also conducted.

After the annealing for 12 days in Ar/5%H2 and in air, the crush load and the grain size of the Li2TiO3 pebbles increased slightly in comparison with the ones before annealing. The Li2.11TiO3+y pebbles annealed in air also showed a similar characteristic change. However, the Li2.11TiO3+y pebbles annealed in Ar/5%H2 indicated a microstructural change and a decrease of the crush load. In order to understand the effect of the reduction on the pebbles in detail, pebbles annealed for 15 and 18 days were also characterized. In this presentation, the effect of the reduction on the pebbles will be discussed with the results of the chemical composition and the crystal phase identified by Inductively Coupled Plasma (ICP) and X-ray diffraction (XRD) respectively.

[1] T. Hoshino et al. Fusion Eng. Des. 82 (2007) 2269-2273