Preparation of lithium-rich lithium titanate ceramic pebbles via sol-gel method

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Abstract: Lithium titanate with excess lithium is one of the most promising candidates among advanced tritium breeders for demonstration power plant reactors because of its good tritium release characteristics. The tritium breeding ratio (TBR) of Li$_2$TiO$_3$ is smaller than that of e.g., Li$_2$O or Li$_8$TiO$_6$ because of its lower Li density. Therefore, new Li-containing ceramic composites with both high stability and high Li density have been developed. Thus, this study focused on the development of a solid solution with a new characteristic. Li$_{2+x}$TiO$_3$ powder was prepared by sol-gel method, and the pebbles was made by wet forming process. The X-ray diffraction patterns of sintered Li$_{2+x}$TiO$_3$ pebbles are approximately the same as those of Li$_2$TiO$_3$ pebbles, and no other peaks are observed. These results demonstrate that Li$_{2+x}$TiO$_3$ pebbles are not a two-phase material but rather a solid solution. Furthermore, the best sintering procedure for Li$_{2+x}$TiO$_3$(x=0.1,0.2,0.3,0.4) powder was studied, and the comprehensive performance of the pebble is analyzed. It has been observed that the Li$_{2.3}$TiO$_3$ pebbles show the desired properties [appreciable density (87%), smaller grain size (<5µm), good sphericity (0.98) and notable crush load (50N)]. Thus, the Li$_{2.3}$TiO$_3$ solid solution is a candidate breeder material for super advanced (SA) tritium breeders.

Key words: Solid solution, Li$_{2.3}$TiO$_3$, Grain size, Relative density, Crush load