Accepted Manuscript

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PII: S0022-3115(16)31271-5

DOI: 10.1016/j.jnucmat.2017.10.043

Reference: NUMA 50575

To appear in: *Journal of Nuclear Materials*

Received Date: 14 December 2016

Revised Date: 10 October 2017

Accepted Date: 17 October 2017

Please cite this article as: J.-H. Kim, M. Nakamichi, Fabrication and characterization of crushed titanium–beryllium intermetallic compounds, *Journal of Nuclear Materials* (2017), doi: 10.1016/j.jnucmat.2017.10.043.

Fabrication and characterization of crushed titanium–beryllium intermetallic compounds

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Abstract

To develop a technique for the mass production of beryllide pebbles, a crushing method for the granulation of beryllides was used in this study. Two types of crushed $Be_{12}Ti$ pebbles were prepared using mortar-ground (MG) and planetary-ball-milled (PM) powders. A granulation yield of approximately 50 wt.% with sizes in the range of 0.85 to 1.18 mm was achieved. Scanning electron microscopy (SEM) images revealed that the MG pebbles exhibited larger porosity because the larger size of the powder resulted in lower density with higher porosity. However, the considerably larger fraction of fine pores in the PM pebbles resulted in an increased Brunauer–Emmett–Teller (BET) specific surface area, as clearly demonstrated by high-magnification SEM images. To evaluate the reactivity with water vapor, the weight gain and H_2 generation rate were also investigated. The results suggested that the PM pebbles exhibited notably lower reactivity, weight gain, and H_2 generation rate, which may be due to the dramatically decreased BET specific surface. The fine pores were filled with stable oxides followed by a significant decrease of the surface area during oxidation. Optimization was performed to improve the circularity of the crushed pebbles. Grinding tests using planetary milling without balls for different times clearly demonstrated that the circularity improved (with an estimated value of 0.8) by cutting and polishing the sharp edges; however, long-duration milling for 99 h resulted in attachment of the polished powders to the pebble surface, leading to surface color variation of the crushed pebbles.

Keywords: crushed pebble, reactivity, H_2 generation rate, planetary milling, circularity,