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Some Properties of Beryllium Pebbles Produced by Powder Metallurgy for HCPB Breeding Blanket Application

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Beryllium is planned to be used as the neutron multiplier in helium cooled pebble-bed (HCPB) breeding blanket concept for DEMO power plants. Under neutron irradiation a large amount of helium and tritium is produced in beryllium. The key issues of neutron irradiation of beryllium are helium-induced swelling and tritium retention and release. Because of safety requirements, the in-pile tritium release should be sufficiently high to avoid risk to personal in case of a serious accident in a fusion power plant leading to abrupt release of all accumulated tritium.
In the present HCPB breeder blanket design, beryllium is used in the form of pebbles with diameter of ˜1 mm, having inherently large grains (in the 500-1000 μm range) due to the fabrication by "Rotation Electrode Method"or "Fluoride Reduction Process". However, it is expected that in beryllium with fine grain structure (average grain size of a few tens micrometers) helium and tritium release can be improved significantly. In order to produce the pebbles with a fine grain structure, some R&D were performed in Bochvar Institute. Several experimental batches of Be pebbles with average pebble size of 1.2 –1.3 mm and different grain sizes (from ˜ 13-14 μm up to ˜615 μm) have been fabricated by powder metallurgy and then characterized.
This paper presents the results of investigation of three batches of beryllium pebbles with average pebble size of 1.2 –1.3 mm and different average grain sizes (13-14 μm, ˜50 μm and ˜615 μm). Microstructure and chemical composition of produced beryllium pebbles are presented as well as packing density and pebble size distribution. The influence of grain size on tritium release and retention in Be pebbles during temperature programmed desorption (TPD) after high-temperature loading of tritium/hydrogen gas mixture are also described.

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