

First results of the post-irradiation examination of the Ceramic Breeder materials from the Pebble Bed Assemblies Irradiation for the HCPB Blanket concept (P4-H-499)

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In the framework of developing the European Helium Cooled Pebble-Bed (HCPB) blanket an irradiation test of pebble-bed assemblies is performed in the HFR Petten. The experiment is focused on the thermo-mechanical behavior of the HCPB type breeder pebble-bed at DEMO representative levels of temperature and defined thermal-mechanical loads. To achieve representative conditions a section of the HCPB is simulated by EUROFER-97 cylinders with a horizontal bed of ceramic breeder pebbles sandwiched between two beryllium beds. Floating Eurofer-97 steel plates separate the pebble-beds. The structural integrity of the ceramic breeder materials is an issue for the design of the Helium Cooled Pebble Bed concept. Therefore the objective of the post irradiation examination is to study deformation of pebbles and the pebble beds and to investigate the microstructure of the ceramic pebbles from the Pebble Bed Assemblies.

This paper concentrates on the Post Irradiation Examination (PIE) of the four ceramic pebble beds that have been irradiated in the Pebble Bed Assembly experiment for the HCPB blanket concept. Two assemblies with Li_4SiO_4 pebble-beds are operated at different maximum temperatures of approximately 600°C and 800°C. Post irradiation computational analysis has shown that both have different creep deformation. Two other assemblies have been loaded with a ceramic breeder bed of two types of Li_2TiO_3 beds having different sintering temperatures and consequently different creep behavior. The irradiation maximum temperature of the Li_2TiO_3 was 800°C. To support the first PIE result, the post irradiation thermal analysis will be discussed because thermal gradients have influence on the pebble-bed thermo-mechanical behavior and as a result it may have impact on the structural integrity of the ceramic breeder materials.