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Development of Functional Materials for CN TBM

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For the Chinese Helium Cooled Ceramic Breeder Test Blanket Module (CN HCCB TBM) design, the tritium breeder and the neutron multiplier are considered as two important functional materials to increase the tritium breeding ratio (TBR) performance. Lithium Orthosilicate is selected as reference tritium breeder material, and Beryllium is selected as neutron multiplier in the design. The main line of functional materials research and development is based on the use of the functional materials in the form of pebble beds. This paper will briefly introduce the current progress on Li4SiO4 pebbles and Beryllium pebbles.

The fabrication process for Lithium Orthosilicate pebbles by melt spraying method has been developed at SWIP. The morphology and surface appearance of the different pebble batches are very similar. Preliminary physical properties of pebbles were characterized. The effective thermal conductivity of Li4SiO4 pebble bed is measured using a hot wire method. The packing fraction was ~ 60% using 1.0 mm diameter pebbles for the single size pebble bed. Helium at atmospheric pressure was used as a filling gas. The effective conductivity was measured as a function of temperature. The experimental results showed that the effective thermal conductivity decreased with the increase of the average bed temperature. In the coming work, an independent adjustment of temperature and deformation experimental apparatus will be designed and built to investigate the thermal mechanical behavior of the beds.

The rotating electrode process (REP) has been adopted to produce beryllium pebbles for impurity control, sharp particle size distributions and mass production. The different size beryllium pebbles have been fabricated by controlling the arc current and velocity of the rotating electrode. The beryllium pebbles look almost perfectly spherical with a very smooth external surface. Preliminary characterizations of beryllium pebbles have been carried out. The plastic deformations of the pebbles have been measured and correlated with the applied loads. The tested sample is not separated into many parts up to 2000N and only one big crack parallel to the compressive force direction is observed. It is observed that the fracture properties of the beryllium pebbles are not affected by pebble size.

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