Status of R&D of advanced neutron multiplier in ITER-BA activity (30) Stability of $Be_{12}V$ pebbles with different sizes at high temperatures

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Application of vanadium beryllide $Be_{12}V$ as a material of neutron multiplier in the breeding blanket of DEMO reactor requires an assessment of its stability at high temperatures. In this work, analysis of microstructure and study of interaction of $Be_{12}V$ pebbles having different sizes with water vapor at high temperatures was performed. In order to investigate the size effect, both, small- and big-sized $Be_{12}V$ pebbles which were produced by Rotating Electrode Method (REM) at QST have been investigated.
Obtained results allow making preliminary conclusions regarding the stability of vanadium beryllide pebbles at high temperatures.

Keywords: neutron mutliplier, vanadium beryllide, stability at high temperatures, binary-sized pebbles

1. Introduction

$Be_{12}V$ pebbles having different sizes were produced at QST using variable electrode rotation speeds by REM granulation. These sizes of pebbles were already successfully applied by the testing of the binary-sized pebble beds with the use of cylindrical containers to fulfill the requirements of DEMO blanket design [1]. In this study, interaction of $Be_{12}V$ pebbles with water vapor (1%) and the evolution of their microstructure were investigated at the upper temperature range of the blanket operation conditions.

2. Summary

2-1. Experimental

Thermal stability of $Be_{12}V$ pebbles was proven from the point of view of kinetics of their interaction with gaseous atmosphere containing 1% of water vapor. The thermal analyzer (NETZSCH STA 449 F3 Jupiter) was used to measure the mass gain of specimens while the hydrogen generation rate (as a product of chemical reaction with H_2O) was evaluated by a gas chromatography method.

2-2. Characterization

Additional investigations included the implementation of the optical digital microscope and Electron Probe Microanalyzer (EPMA) for the observations of the pebbles surfaces and cross-sections as well as the evaluation of the specific surface what was needed for the exact determination of the chemical kinetics by the reaction with water vapor.

2-2. Discussion

Obtained results allow making the preliminary assessment of the chemical reactivity of $Be_{12}V$ pebbles with water vapor from the point of view of their use in DEMO blanket. Also, the influence of the sizes of pebbles on the chemical reactivity is discussed in this study.

References

[1] P. Kurinskiy, J.-H. Kim, M. Nakamichi, Fabrication and characterization of $Be_{12}V$ pebbles with different diameters, Fusion Engineering and Design, in Press (available online).