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Characterization of modified Be13Zr beryllide as advanced neutron multiplier

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Hydrogen generation reaction with water vapor of Be at high temperatures and BeO produced by this reaction that is harmful to human bodies are major drawbacks. Advanced neutron multipliers with high stability at high temperatures are desirable for fusion reactors where coolant water is extensively used. Beryllides have strong potential for use in high-temperature environments. In the framework of Broader Approach (BA) activities, beryllide pebbles as the advanced neutron multiplier were successfully fabricated by a combination of a plasma sintering synthesis method and a rotating electrode granulation method (REM).
Beryllide disturbs the tritium breeding by the metal in Be such as Ti, V. Therefore, Be13Zr was selected, because Be13Zr not only has low neutron absorption property, but also has no peritectic reaction during granulation. Be13Zr pebble has been successfully fabricated directly by REM using the plasma-sintered Be-Zr electrode. However, Be13Zr has pest phenomenon. Pest reaction occurs during oxidation at relatively low temperatures, and is disintegration of polycrystalline sample cased by oxidation. The disintegration into powdery products is occurred by the growth of oxide along the grain boundary or crack. As action on this issue, dispersion of insoluble element for reduction of oxidation reaction was tried. Si has been selected as dispersion element, because they have low solubility in Be and low neutron cross-section. From the optimization result, Be13Zr without pest reaction was successful in developing by addition of Si. It is supposed that pest reaction was prevented by reduction of stress of oxidation reaction caused by dispersion of Si in grain boundary of Be13Zr. In the present study, the characterization of modified Be13Zr by the addition of Si without pest reaction will be introduced, such as thermal and chemical properties.

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