Melting and Solidification Behavior of Type 316L Austenitic Stainless Steel Containing 30mass% B4C

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In core disruptive accidents of sodium-cooled fast reactors, complex core disruptive behaviors due to eutectic reactions between control rod materials (B_4C) and reactor structural materials (type 316 austenitic stainless steel (SS)) are observed. The authors have obtained various thermophysical property data of the B_4C-SS melt to be used for simulating this core disruptive accident [1, 2]. To further analyze the eutectic reaction mechanism in detail, it is necessary to clarify the melting and solidification processes of B_4C-SS materials. However, SS with a high concentration of B_4C has a high liquidus temperature, which is difficult to measure with existing thermal analyzers. Therefore, we have developed an ultra-high temperature thermal analysis method using blackbody radiation, and have conducted thermal analysis of the melting and solidification behavior of SS containing various concentrations of B_4C.

In this study, we attempted thermal analysis of the melting and solidification process of SS containing 30 mass% B_4C, which is the highest concentration so far, using the same method. Several endothermic and exothermic peaks were identified due to the melting and solidification of B_4C-SS. Thermal analysis was performed up to 2450 K, but complete melting was not achieved. To elucidate the phase relations in the melting and solidification processes of B_4C-SS, microstructural observation and phase identification of the samples obtained by quenching the melted samples by electromagnetic levitation were carried out. As a result, it was found that graphite, B_4C, and the liquid phase coexisted at temperatures around 2450 K. These results will be reported in more detail at the symposium.

Acknowledgments

This study was supported by the "Technical development program on a common base for fast reactors" entrusted to the Japan Atomic Energy Agency (JAEA) by the Ministry of Economy, Trade and Industry (METI).

References

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