Numerical analysis of heat and mass transfer of Ga_2O_3 grown by skull melting method

*Koichi Kakimoto[1], Isao Takahashi[2], Taketoshi Tomida[2], Yusuke Kida[2], Kei Kamada[2], Satoshi Nakano[3], Akira Yoshikawa[1, 2, 4].
E-mail: kakimoto@riam.kyushu-u.ac.jp
1 NICHe, Tohoku Univ. JAPAN
2 C&A Co.2, JAPAN
3 RIAM, Kyushu Univ. JAPAN
4 IMR, Tohoku Univ. JAPAN

Skull melting method is one of the promising methods of crystal growth to grow crystals with high quality. Takahashi et al. reported experimental results of crystal growth of Ga_2O_3 using a skull melting method [1]. They reported transparent crystals by adding oxygen partial pressure in gas phase during crystal growth.
We carried out heat and mass transfer during crystal growth of Ga_2O_3 grown by skull melting method by using a global model [2] to study how temperature and velocity fields as well as interface shape between a crystal and the melt behave during crystal growth.
Figure 1 depicts temperature and velocity distributions in the melt before seeding process. The temperature distribution at the top center of the melt shows concave shape. This means the interface shape becomes concave. Flow direction in the bulk melt is opposite to that of the conventional Czochralski or directional solidification methods.
Figure 2 depicts temperature and velocity distributions in the melt before seeding process. The interface shape is concave which is identical to that of CZ method reported by Miller et al. [3]. We studied the distributions of temperature and velocity, and interface shape as a function of coil position as well as RF frequency. The details will be presented at the conference.

References

[1] I. Takahashi, et al., JSAP fall meeting, (2022), 20-p-B203-9.
[2] S. Nakano, B. Gao and K. Kakimoto, J. Cryst. Growth, 375 (2013) 62.
[3] W. Miller, K. Bottcher, A. Galazka and J. Schreuer, Crystals, 7 (2017) 26.

Acknowledgement: This paper is based on results obtained from a project, JPNP21005, subsidized by the New Energy and Industrial Technology Development Organization (NEDO).

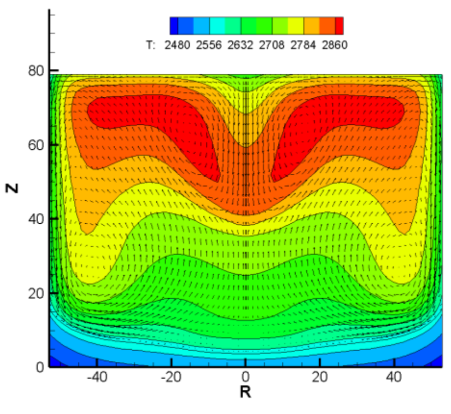

Fig. 1 Temp. and velocity distributions in a crucible.

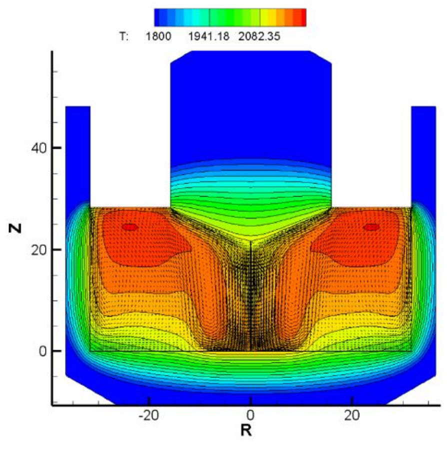

Fig. 2 Temp. & velocity distributions during crystal growth.