Bulk Growth
Room Bansal Atrium - Session BG-TuP
Bulk Growth Poster Session II

BG-TuP-5 β-Ga_2O_3 Single Crystal Growth by EFG Method using Die with Multi-Slit Structure, ***Yeon-Geun Seong***, *Y. Moon,* Axel, Republic of Korea*; H. Jang, S. Choi, C. Min-Ji, S. Seo, M. Park, Y. Jang, W. Lee,* Dongeui University, Republic of Korea*; J. Kang,* Axel, Republic of Korea

β-$Ga_2O_3$is attracting attention as a next-generation power semiconductor. β-Ga_2O_3 has a high bandgap of 4.9eV and a high breakdown voltage of 8MV/cm. In addition, β-Ga_2O_3 grown by the EFG (Edge Defined Film-Fed Growth) method is superior to other power semiconductor materials such as SiC and GaN due to its fast growth rate and low manufacturing cost. However, since the β-Ga2O3 crystal grown by the EFG method grows in a ribbon morphology, the number of wafers that can be extracted from one ingot is small. [1-4]

In this study, the thickness of the ingot was increased through a die with multi-slit structure. Crystal growth from multi-slit structure is divided into 'diameter direction', which determines the size of the wafer, and 'thickness direction', which determines the extraction numbers of wafer. As a result of β-Ga2O3 growth experiments using Muliti-Slit Die, we found that thick crystal growth is difficult if the growth rate in the diameter direction is too fast, and polycrystals are easily to occur if the growth rate in the thickness direction is too fast. Therefore, in order to overcome these problems, the two-dimensional temperature distribution and the temperature gradient in the vertical direction were adjusted to secure reproducibility to stably grow thick crystal with high crystallinity.

As a result of the experiment, various process conditions, such as the type and structure of insulation, three-dimensional temperature gradient, and pulling speed, had a more sensitive effect on the growth of thickness direction in multi-slit die compared with single-slit die. By adjusting the thermal balance of upper and lower parts of crucible and the temperature gradient of die in diameter direction and thickness direction, the growth of thick β-Ga2O3 single crystals was successfully achieved. This result can contribute to lower the manufacturing cost of Ga2O3 crystals as a substrate for power semiconductor fabrication.

Reference

[1] J. Y. Tsao et al, Adv. Electron. Mater. 4, 1600501 (2018)

[2] M. Higashiwaki, G.H. Jessen, Appl. Phys. Lett. 112, 060401 (2018)

[3] Kun Zhang et al, J. Alloys and Compounds, 881,160665 (2021)

[4] Shengnan Zhang et al, J. Semicond. 39, 083003 (2018)

Author Index

Bold page numbers indicate presenter