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PVT 成長法を用いた 4H-SiC 単結晶における基底面転位の低減に対する ヒーター電力制御の最適化

Optimization of power control in the reduction of basal plane dislocations during PVT growth of 4H-SiC single crystals

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Introduction

In SiC bulk PVT growth, BPDs are mainly generated and multiply during high-temperature processes, such as the crystal growth process and cooling processes. Optimization of crystal growth and cooling processes could reduce the generation of BPDs. In this paper, the model proposed in Ref. 1 is extended to a three-dimensional (3D) model, and the deformation-induced dislocations (BPDs) are considered to be responsible for the high-temperature plastic deformation. The model is used to study the influence of power control on the multiplication of BPDs during crystal growth of 4H-SiC. We aim to clarify the following problems: What type of power control during growth is best for reducing BPDs? What type of power control during growth is a good choice for reducing BPDs and also for increasing the growth rate?

Design power-control method

Three sets of power histories are used to test power effect: (a) The total power generated inside the graphite crucible was kept constant; (b) The total power generated inside the graphite crucible was continuously decreased from 8398 W to 6743 W; (c) The total power generated inside the graphite crucible was continuously increased from 6743 W to 8398 W.

Results

The distribution of BPD density inside crystal for constant power control (case 1 and 2) is shown in Fig. 1. The maximum BPD density for case 1 is 4300 cm^{-2}; however, for case 2, it is only 972 cm^{-2}. The only difference between two cases is that case 2 has a lower power level than case 1. Therefore, low power level is beneficial to growing crystal with low BPD density.

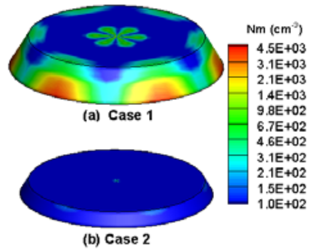

Fig. 1. Distribution of BPD density inside crystal for constant power. (a) Constant high power value; (b) constant low power value.

References

[1] B. Gao, K. Kakimoto, *J. Cryst. Growth* **2014**, 386, 215–219.