3インチ SiC 溶液成長における溶液流れの切り替えによるインクルージョン抑制と高品質化

High quality and inclusion suppression by switching flow in 3-inch SiC solution growth

名大[1], 産総研[2] ○朱 燦[1], 遠藤 友樹[1], 原田 俊太[1], 田川 美穂[1], 宇治原 徹[1,2]

Nagoya Univ.[1], AIST[2], ○Can Zhu[1], Tomoki Endo[1], Shunta Harada[1], Miho Tagawa[1], Toru Ujihara[1,2]

E-mail: zhu@unno.material.nagoya-u.ac.jp

In the solution growth of SiC, threading dislocations conversion by the macrosteps were observed [1], and ultra-high-quality crystal were achieved [2]. On the other hand, the development of macrosteps leads to the formation of macroscopic defects such as solvent inclusion, which degrade the crystal quality. Therefore, it is necessary to control the macrostep. In our pervious study, to stabilize step flow over the entire crystal, the switching flow growth method was proposed [3]. In this study, we investigate the effect of switching flow on the TSD conversion and the inclusion suppression in 3-inch SiC growth.

Crystal growth experiments were conducted by TSSG method. The simulation was calculated by CGSim™ (STR Japan). By changing the rotation speed of seed and crucible rod, 2 favorable solution flow patterns were achieved. Condition 1 is that the solution flow near the seed crystal is from the center to the outer periphery, and condition 2 is that the solution flow is from the outer periphery to the center. Switching flow growth is performed by periodically alternating condition1 and 2.

Fig. 1 shows the surface morphology of 3-inch crystal after the switching flow growth. Uniform step morphology was observed. X-ray topography images of upstream area (a) and downstream area (b) of step flow were shown in Fig. 2. TSD conversions can be observed in both area (white arrows). No inclusions were observed in the X-ray topography images, which indicates that the formation of the inclusions was successfully suppressed by the switching flow growth. The average TSD density in this crystal is 470 cm^{-2}. This result shows that we can grow inclusion-free 3-inch SiC crystal with low TSD densities by the switching flow technique.

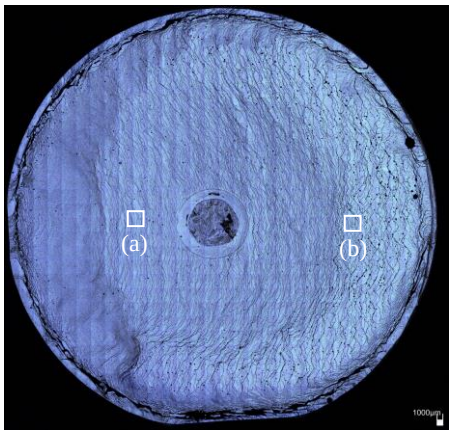

Fig. 1 Surface morphology of 3-inch 4H-SiC crystal after the switching flow growth for 6h.

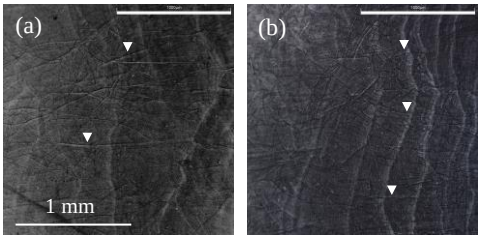

Fig. 2 X-ray topography image of (a) up-stream of step flow and (b) down-stream of step flow.

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