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Defect evolution in high-quality 4H-SiC grown by solution method

S. Harada[1], M. Tagawa[1], T. Ujihara[1]

[1]*Nagoya University, Department of Materials Science and Engieering, Nagoya, Japan*

Silicon carbide (SiC) has been receiving great interest due to its potential application as a next-generation power device. For the high-performance SiC power device, a high-quality SiC wafer is necessary. Commercial SiC wafers are usually produced by physical vapor transport (PVT) method. The crystal quality of the commercial wafers has been improved and the density of micropipes which cause the degradation of break down voltage has been almost eliminated. However, thousands of dislocations still exist in the wafers. Solution growth is one of the methods to achieve high-quality crystal growth because the condition of solution growth is close to thermal equilibrium. Many researchers studied top-seeded solution growth (TSSG) method for the high-quality bulk growth of SiC. So far high growth rate (2 mm/h) and large diameter growth (3 inches) has been demonstrated by this method. Recently we have investigated the defect evolution during the solution growth of SiC. In the solution-growth crystal, threading screw dislocations (TSDs) propagating to the growth direction was converted to defects on the basal planes by macrosteps formed on the growth surface. By using the vicinal seed crystal, we can successfully form a large number of macrosteps on the growth surface and most of TSDs were efficiently converted to the defect on the basal planes. The defects on the basal planes are propagating to the direction vertical to the growth direction and are finally wiped out as the growth proceeds. Actually by utilizing the TSD conversion during the solution growth, we obtained high-quality crystal with very low TSD density. The TSD density of the solution growth crystal was only 30 cm-2, which is two-order magnitude lower than that of the commercial wafers.

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