Metastable Solvent Epitaxy of SiC; another diamond synthesis

S R. Nishitani, T. Kaneko[1] and N.Ohtani[2]

Department of Informatics, Kwansei Gakuin University,
Gakuen 2-1, Sanda, 669-1337 Japan. (email: nishitani@kwansei.ac.jp)

1 Department of Physics, Kwansei Gakuin University.

2 The Research and Development Center for SiC Materials and Processes, Kwansei Gakuin University.

Professor W. Shockley, a Nobel prize winner and the "father of the transistor", predicted in the 1950s that SiC would quickly replace Si, because of its superior material properties for use in devices[1]. His prediction has not yet come true, because of the huge costs of making SiC wafers. The price of SiC wafers is close to that of diamond jewels rather than to that of Si wafers. Nevertheless, owing to its promissing physical properties for high-power devices and for achieving tremendous reductions of CO2 emission, many researchers and companies are purchasing many SiC wafers. Besides the price, there are other similarities between SiC and diamonds: (1) both have strong sp3 covalent bondings that give rise to the local coordination number of four, and (2) 4H SiC has many polytypes such as 3C, while diamond has the polytype of graphite.

SiC wafers have been made by the sublimation method. Because the growth rate of SiC crystal is extremely low, a few weeks of operation at temperatures above 2000 deg C is necessary. During such a long operation, many grown-in defects, such as impurities, hollow cores and stacking faults, come to be included. To avoid them, the operation temperatures, their gradients, and gas atmosphere should be controlled precisely, which makes the cost tremendously high.

Very recently, the authors reported a novel process of fabricating epitaxial SiC[2]. This process possesses the potential to drastically reduce the cost of making SiC wafers. The driving force of the system is the same as that in the diamond synthesis reported by Bonenkirk et al. of GE in 1959[3]. We will report another diamond synthesis of SiC in this paper.

References:

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