【T-05】

Low temperature 4H-SiC epitaxial growth on 4H-SiC $(11\bar{2}0)$ and $(1\bar{1}00)$ faces by organo-metallic chemical vapor deposition

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Silicon carbide (SiC) is a newly emerging material for high-temperature, high-frequency and high-power devices, since it has a high breakdown field ($\sim 3\times10^6$ V/cm), high thermal conductivity, high saturated electron drift velocity ($\sim 2\times10^7$ cm/s) and chemical stability. Recently 4H-SiC polytype is highlighted for its two times higher electron mobility with its small anisotropy and lower ionization energies of shallow dopants compared to 6H-SiC. We have previously reported that the use of the precursor bis-trimethylsilylmethane (BTMSM, $C_7H_{20}Si_2$) resulted in a 150K reduction in the deposition temperature for 3C-SiC and α-SiC on Si and 3.5~8°off-axis α-SiC substrate, respectively [1 4].

In this paper, silicon carbide thin films were grown on $(11\bar{2}0)$ and $(1\bar{1}00)$ 4H-SiC substrates by chemical vapor deposition using a single precursor material, bis-trimethylsilylmethane at substrate temperatures ranging from 990 to 1400℃. On the $(11\bar{2}0)$ faces, high quality 4H-SiC homoepitaxial thin films was grown above 1200℃ while amorphous SiC films were obtained below 1100℃. Very narrow x-ray rocking curves with a full-width-at-half-maximum of 6.9 arcsec were observed for the 4H epilayer grown on $(11\bar{2}0)$ at 1200℃. On the $(1\bar{1}00)$ faces, monocrystalline 4H-SiC films were grown even at the extremely low temperature of 990℃, which is about 500℃ lower than the conventional growth temperature. It is believed that enough decomposition of the source material, bis-trimethylsilylmethane, at such a low temperature and the atomic arrangement of the a face containing the 4H stacking sequence(ABCB·) makes extremely low temperature epitaxy possible.

[References]

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