[I-7] [초청]

Heteroepitaxial Growth of Silicon Carbide Thin Films by High Vacuum Chemical Vapor Deposition Using the Single Precursor 1,3-Disilabutane

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Silicon carbide has been gaining popularity as a compound semiconductor material for applications such as high power, high frequency, and high temperature electronic devices. Heteroepitaxial growth of thin films of silicon carbide on silicon is usually carried out by chemical vapor deposition using separate sources of silicon and carbon, namely silane and propane. This process requires high deposition temperatures often exceeding 1300 ^{0}C. The source chemical silane is quite pyrophoric and therefore extreme caution is needed in handling. The use of separate sources for silicon and carbon requires carbonization of the silicon substrate surface prior to the growth of the silicon carbide films. After carbonization, precise control of the flow rates of source chemicals is necessary in order to obtain accurate stoichiometry. All of these cause difficulties in growing silicon carbide films.

The single precursor 1,3-disilabutane, $H_3SiCH_2SiH_2CH_3$, has two silicon atoms bonded alternatingly to two carbon atoms, and therefore is a good single source for the deposition of silicon carbide. It is a liquid at ambient temperature, has a reasonably high vapor pressure, and most importantly, is stable in air. Chemical vapor deposition of silicon carbide thin films using 1,3-disilabutane has turned out to have the following advantages over the conventional chemical vapor deposition that uses separate sources.

1) Handling of the source chemical is safe and simple.
2) The deposition temperature is lowered by more than 300 ^{0}C.
3) Accurate stoichiometry of the silicon carbide film is easily achieved.
4) Carbonization of the silicon substrate is not necessary.

Recent work has shown that the deposition temperature can be as low as 700 ^{0}C while still maintaining the epitaxial growth characteristics. In this presentation a review of our research on the heteroepitaxial growth of silicon carbide thin films on silicon will be given emphasizing the importance of employing single precursor chemical vapor deposition.