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Effect of partial pressure of phosphine on ordering in $Ga_{0.5}In_{0.5}P$ (Phosphine의 분압이 $Ga_{0.5}In_{0.5}P$ Ordering현상에 미치는 영향)

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GaInP lattice matched to GaAs is of considerable importance for photonic devices and electronic switching devices. CuPt ordering is known to spontaneosly occur in GaInP layers grown by organometallic vapor phase epitaxy(OMVPE). Formation of CuPt-type ordered structure has an influence on the materials properties of semiconducting layers i.e. a reduction in band gap. Therefore, ordering must be fully characterised to growth conditions. In this work, we have investigated effect of PH_3 partial pressure on the degree of order and antiphase boundaries(APBs) in GaInP OMVPE layers.

The $Ga_{0.5}In_{0.5}P$ layers were grown on exactly-oriented (001) GaAs substrate by OMVPE. The growth temperature was 670°C. The flow rates of the group-Ⅲ source materials were held constant. The input partial pressure of the phosphorus precursors (PH_3) varied from 0.9 to 18 Torr. Transmission electron microscopy(TEM) and transmission electron diffraction(TED) were performed to characterise the ordering and associated structure.

CuPt-type ordering was found to be dependent on the PH_3 partial pressure. TEM dark field images showed that all the layers contain a number of APBs. There are a few interesting features. First, as the PH_3 partial pressure increased, the APBs density seemed to decrease, reach a minimum at PH_3 = 6, and then increase. Secondly, the APBs were inclined a few degree from the [001] growth direction. The inclination appeared to increase, reach a maximum at PH_3 = 6, and then decrease: the angle ranging from ~10 to ~18.8° . The degree of order appeared to be dependent on PH_3 partial pressure. The intensity of extra spots (and hence the degree order) increased, reached a maximum at PH_3 = 6, and then decreased. Possible mechanism is proposed to explain these phonomena.