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# 원자 규칙화 정도에 따른 InGaP double layer에 대한 연구

## ( A study of InGaP double layer on a degree of order )

광주과학기술원: 조 제 희, R. Spirydon, 성 태 연

Univ. of Utah : G. B. Stringfellow

Epitaxial layers of ternary and quaternary Ⅲ-Ⅴ alloys grown by a variety of techniques have been found to exhibit several types of atomic ordering which may have marked effects on the electrical and optical properties of these layer. CuPt-type ordering is most commonly reported to occur in mixed group Ⅲ and Ⅴ alloy layers.

The ordering is well known to result in a reduction in the bandgap; the amount of reduction is dependent upon the degree of order. The degree of order can be controlled by the variations of growth parameters, such as growth temperature and Ⅴ/Ⅲ ratio, etc. It is of technological advantage to make heterostructures where the bandgap changes while the atomic composition remains the same.

The four samples investigated are two single layers of ordered GaInP and two heterostructures. The heterostructures consist of the more ordered (lower bandgap) layer with 0.75 torr of $PH_3$ pressure and the less ordered (higher bandgap) layer with 0.1 torr of $PH_3$ pressure. The only difference of two heterostructure was that the latter one had 25 minute interruption prior to the deposition of the 2nd layer. All samples were grown by metal organic vapor phase epitaxy (MOVPE) on semi-insulating GaAs substrates on axis toward (001). The ordering in the GaInP layers was investigated by photoluminescence (PL) and transmission electron microscopy (TEM).

As for the single layers, we found a reduction in the bandgap: i.e. 1.889 eV for 0.75 torr of $PH_3$ and 1.957 eV for 0.1 torr of $PH_3$. The PL data showed that the reduction of the bandgap of the heterostructure which was grown with 25 minute interruption was larger than that of the one without interruption.

TEM result of the heterostructure without interruption showed that the ordering persisted across the upper layer, which was attributed to memory effect. However, as for the heterostructure with 25 minute interruption, such persistence was retarded significantly. Lattice image simulation was employed to qualitatively investigate the degree of order in these layers.