Departamento de Física de Materiales

SEMINARIO

Composition fluctuations and triple-period atomic ordering in $GaAs_{1-x}Bi_x$ layers grown by molecular beam epitaxy

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VIERNES 8 DE NOVIEMBRE A LAS 12:00

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Novel III-V-Bi compounds have recently emerged as a new research field in semiconductor science and technology due to their peculiar electronic properties. Furthermore, the interest in this material goes beyond opto-electronics and basic material-related properties such as metastability, segregation, solubility limits, etc are still unknown. III-V-Bi compounds are highly-mismatched alloys (HMA), which are formed by the isoelectronic substitution of elements with very different size and/or electronegativity in the anion sublattice. As a consequence, HMAs are often affected by miscibility gaps which makes their growth challenging due to the phase separation tendency of the alloy.

In this work, we investigate the microstructure of $GaAs_{1-x}Bi_x$ (x=1.4-5%) epilayers by transmission electron microscopy (TEM). The layers are grown by molecular beam epitaxy (MBE) at low temperatures between 220-315°C. We find that the samples exhibit a complex microstructure, which is strongly dependent on the growth conditions. While the layers grown at the higher T_s (315°C) show a homogeneous Bi incorporation, the layers grown at the low T_s = 220°C exhibit clear and well-defined lateral composition modulations (LCM). Our experimental observations suggest that the LCM proceed via *surface* spinodal decomposition occurring during growth. Furthermore, depending on the growth conditions, atomic ordering is also detected, thus some layers present simultaneous LCM and atomic ordering. Unlike other works reporting CuPt-ordering in $GaAs_{1-x}Bi_x$, we find clear evidences of a new class of triple-period ordering (TPO) on {111} planes. Although the exact formation mechanisms of the LCM and of the ordered phase are not yet clear, we link the peculiar microstructure of the $GaAs_{1-x}Bi_x$ layers to the specific surface reconstruction present during growth.