Surfactants have been used during organometallic vapor phase epitaxy (OMVPE) to control the properties of III/V semiconductor layers. The group V surfactants Sb, Bi, As, and N, which do not act as dopants when incorporated into the III/V semiconductor layers, have been observed to produce major effects on the electrical and optical properties.

For GaInP, which is ordered when grown without surfactants, all of the surfactants studied result in the growth of nearly disordered material. This results in an increase in the bandgap energy by as much as 160 meV. This phenomenon can be used to make double heterostructures with no change in solid composition (1). The effect is due to a reduction in the surface driving force for ordering, supplied by the P dimers on the (2x4) reconstructed surface. SPA data show that the P dimer concentration on the surface is decreased by the addition of surfactant. For Sb, Bi, and As the dimer spacing is increased, which reduces the driving force for ordering (2). N on the surface is believed not to dimerize at all: It simply displaces P dimers. The results for Sb are in agreement with first principles calculations showing that low surfactant concentrations leave the surface reconstruction unchanged, as P is simply replaced by Sb (3). For high Sb concentrations on the surface the ordering is found to change markedly to one with a triple period. This is explained by the calculations as due to formation of a (2x3) reconstruction (3). Even higher Sb concentrations on the surface lead to formation of a compositionally modulated structure that reduces the photoluminescence (PL) peak energy. It also results in highly polarized PL.

The surfactant Sb is observed to increase the incorporation of dopant quantities of Zn and In into GaAs (4). The incorporation of N into GaAs is significantly decreased by the presence of Sb and Tl. This is interpreted in terms of competition for surface sites using the Langmuir model (5).

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