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GROWTH AND CHARACTERIZATION OF HIGH PURITY LATTICE MATCHED GAIN--ETC(U)
JUN 79 J D OLIVER, L F EASTMAN N00014-75-C-0739

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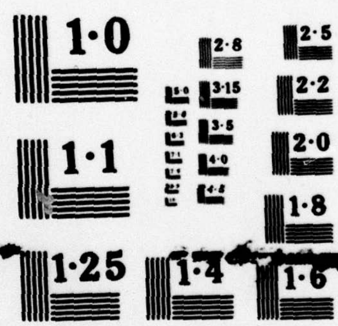
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(6) GROWTH AND CHARACTERIZATION OF HIGH PURITY LATTICE MATCHED GaInAs on InP,

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ABSTRACT

The high mobility of GaInAs allows its potential use as a field effect transistor active layer in either microwave, or high speed logic applications, provided that doping levels can be adequately controlled. At the present, doping levels of less than $10^{16}cm^{-3}$ are difficult to achieve.[1] Previous studies have identified silicon as the major residual donor in InP[2] and GaAs. Here we report on the highest purity GaInAs produced, by carefully controlling the incorporation of silicon.

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It is shown that the thermochemistry of the process

$$Si(\ell) + H_2O(g) \rightleftarrows H_2(g) + SiO(s)$$

is applicable and is supported by the experimental results. Using the purging process of long time baking at the growth temperature, we have achieved room temperature Hall results:

$$n_{RT} = 5\rightarrow10\times10^{14}cm^{-3},\ \mu_{RT} = 11,500\rightarrow13,500\ cm^2/V.sec$$

and liquid nitrogen Hall mobilities as high as $\mu_{77} = 57,000\ cm^2/V.sec$ with little freeze out. The nitrogen mobility (μ_{77}) increases with baking time and has not yet reached its equilibrium value.

This high mobility supports the predictions that alloy scattering may not have as great an effect as was originally thought.[1]

Variable temperature Hall analysis is being conducted in an attempt to estimate the amount of scattering by various mechanisms. This will enable us to estimate the total ionized impurity density, as well as the extent of alloy and space-charge scattering in our high purity material.

X-ray techniques were used to measure the mismatch and structural quality of the high purity layers. Diffraction techniques showed that the mismatch was less than .06% $\frac{\Delta a}{a}$ and that the lattice constant was uniform over the entire layer. An electron microprobe was used to measure the material composition. No evidence of inclusions or inhomogenities was found.

References:

1. Littlejohn, Sadler, Glission, Hauser, 7th Intl. Symp. on GaAs, 1978, to be published.

2. Wrick, Ip, Eastman, J. Electronic Materials, Vol. 7, No. 2, 1978.