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AlInAs/GaInAs HIFETs (Hetero-Interface FETs) grown by Normal pressure MOCVD Using Triethylmetals

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Selectively doped AlInAs/GaInAs heterostructures have widely been studied because of their high mobility and large discontinuity of conduction band edge. The heterostructures have successfully been grown by MBE[1], however, no-one has reported on the growth by MOCVD. We succeeded, for the first time, in the growth of device quality AlInAs/GaInAs heterostructures on semi-insulating (100) InP by a normal pressure MOCVD.

The source materials used were triethylmetals (TEAl, TEGa, and TEIn) and AsH_3. Excellent morphorogy was obtained at the growth temperature around 560°C. Disilane (Si_2H_6) was used for n-type doping to AlInAs, and a very high doping level of $7x10^{18}cm^{-3}$ was obtained.

Figure 1 shows the relation between the sheet carrier densities and the electron mobilities of a selectively doped heterostructure (Nd = $6x10^{18}cm^{-3}$, spacer thickness = 100A) at room temperature. Mobilities near $10000cm^2/Vs$ were obtained in the range of the sheet carrier density from $1x10^{12}cm^{-2}$ to $3x10^{12}cm^{-2}$. A sample with a spacer layer of 50A (Nd = $2x10^{18}cm^{-3}$) showed the maximum electron mobility as high as 10500 cm^2/Vs at room temperature with a sheet electron density of $2.7x10^{12}cm^{-2}$.

We fabricated HIFETs (hetero-interface FETs) using these heterostructures. Al was evaporated and lifted off to form the gate electrode. The ohmic contacts were formed by alloying the metals (AuGe-Ni) at 300°C. The contact resistance of about 0.3Ωmm was obtained from a transmission line method. Figure 2 shows the FET characteristics of a HIFET (gate length = 1.5μm) operated at room temperature. The HIFET showes good pinch-off characteristics, and the maximum transconductance of 302mS/mm was obtained.

〈REFERENCE〉
1) H.Hirose, K.Ohata, T.Mizutani, T.Itoh, and M.Ogawa
GaAs and Related Compounds, Karuizawa, Japan, 1985 (529page)

Figure 1

The relation between the sheet carrier densities and the electron mobilities of a selectively doped heterostructure at 300K. The dopind density in AlInAs was $6x10^{18}cm^{-3}$, and the spacer layer thickness was 100A .

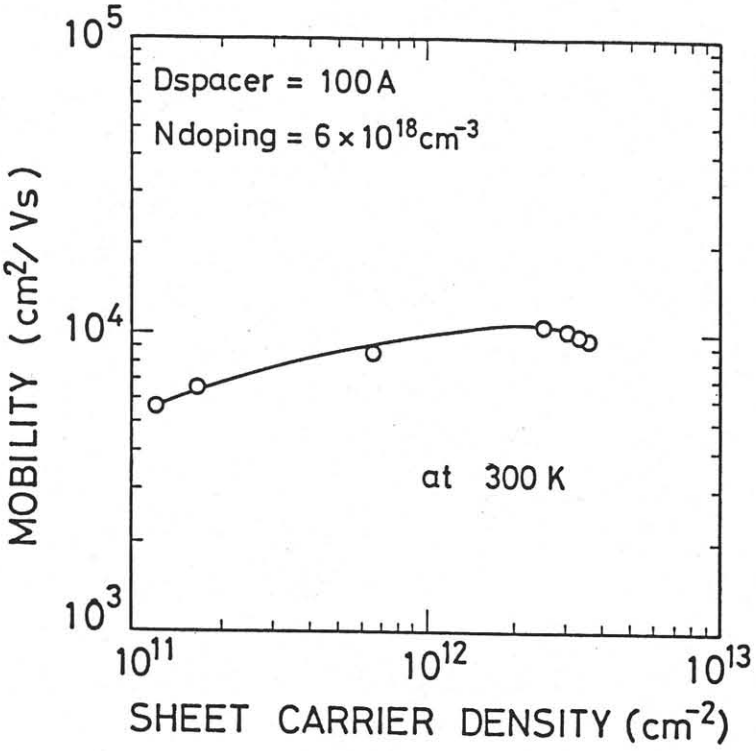

Figure 2

The FET characteristics of a HIFET at 300K.

Lg = 1.5μm
Lsg = 1.4μm
Wg = 19 μm

The maximum gate voltage was 0.8 V. The maximum transconductance was 302mS/mm.