

Deep Levels in MOCVD InP / S.I. InP Structure
Used for InP MESFET

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We have evaluated the deep levels in InP grown by MOCVD on the Fe-doped semi-insulating InP substrate by DLTS and photo-excited DLTS technique in order to characterize behavior of deep impurities in the epitaxial layer such as Fe or Cr and to investigate their influence upon a looping phenomenon in the drain I-V characteristics of InP MESFET's.

InP thin epitaxial layers were grown on the Fe-doped (100) InP substrates by MOCVD at 650 °C under similar growth conditions described previously.¹⁾ The carrier concentration and the Hall mobility were found to be $4 \times 10^{16} \text{ cm}^{-3}$ (n type) and $3000 \text{ cm}^2/\text{Vsec}$ at room temperature, respectively.

A typical DLTS spectrum for the InP layer grown on the Fe-doped semi-insulating substrate is shown in Fig. 1, in comparison with that for an InP layer on the undoped substrate.²⁾ New peaks designated as F1 and F2 appear in addition to a small shoulder corresponding to MOE2. From the slope of Arrhenius plots, activation energies have been found to be 0.48 eV for F1 and 0.78 eV for F2.

The concentration profiles for these levels are shown in Fig. 2. The concentration of F2 is decreasing, as approaching to the surface, indicating that F2 is due to a kind of impurity coming from the substrate. The F1 profile seems to be reflecting the carrier concentration profile, implying that the origin of F1 is a kind of donor-impurity complex formed during growth.

The concentrations of these levels are one to two orders of magnitude lower than the Fe concentration $\sim 10^{15} \text{ cm}^{-3}$ in the semi-insulating substrate. From these results, we can attribute F1 and F2 levels to defects related to Fe impurity diffused from the substrate.

We have concluded that the F1 and/or F2 traps observed here are really responsible for the looping phenomenon in the I-V characteristics of InP MESFET grown by MOCVD.

References

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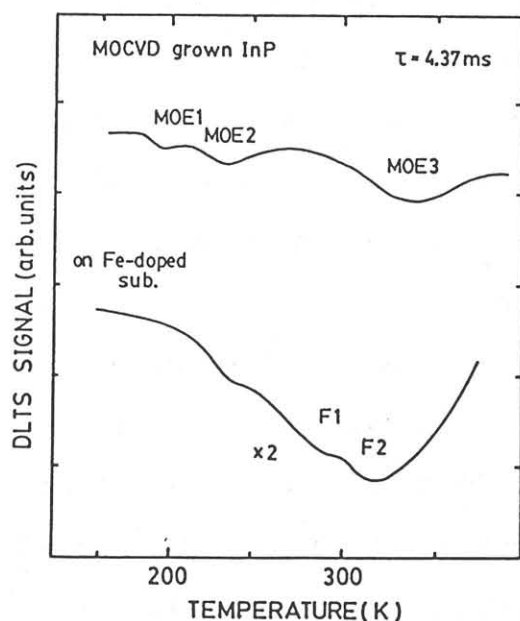


Fig. 1 Typical DLTS spectra for the InP layers grown by MOCVD on the undoped and Fe-doped substrate.

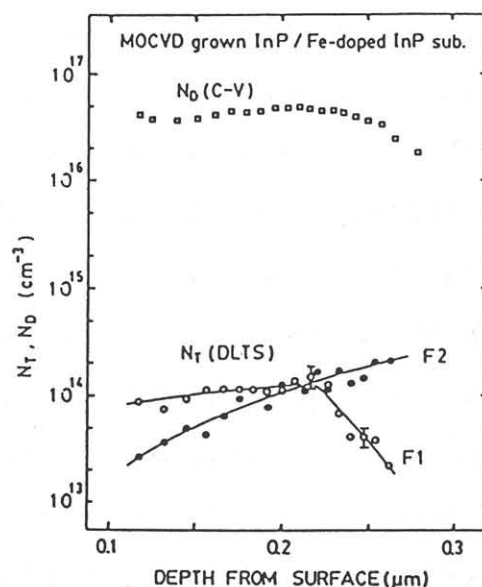


Fig. 2 Concentration profiles for the F1 and F2 levels.