High mobility 2D electrons in undoped InN epitaxial layers grown on N-polarity GaN buffer

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It was established that in epitaxial InN films beside bulk electrons there is always a thin (~10 nm) low-mobility electron accumulation layer on the InN surface. In this paper we report on another 2D electron channel with high mobility, existing in undoped InN samples. We measured Shubnikov de Haas (SdH) oscillations at 1.5 – 4 K as well as conductivity tensor σ_{xx} and σ_{xy} as a function of magnetic field for T between 4 K and 300 K. We observed two sets of SdH oscillations giving evidence of two high mobility electron contributions (Figure 1). The SdH measurements performed at tilted magnetic field revealed that one of them was of 2D character. Basing on magnetic field dependences of σ_{xx} and σ_{xy} tensor, we performed mobility spectrum analysis [1] (it is an established method to determine the contributions to the conductivity and corresponding mobilities in multicarrier semiconductor systems). The obtained mobility spectrum $\sigma(\mu)$ exhibited three peaks corresponding to different electron contributions to the conductivity: low mobility one which we attributed to the surface electrons and two high mobility contributions (Figure 2). To distinguish which one corresponds to 2D electrons we calculated electron concentrations of each contribution expressed both in cm^{-2} and cm^{-3}. Comparison of these values with the ones obtained from the period of SdH oscillations allowed to associate the peaks to the proper conductivity channels. Magnetic field dependences of σ_{xx} and σ_{xy} measured as a function of temperature allowed to observe evolution of the 2D mobility spectrum versus the 3D one with increasing temperature. In conclusion we suggest that 2D high mobility electrons originate from the InN/GaN interface.

[1] S. Kiatgamolchai, M. Myronov, O. A. Mironov, V. G. Kantser, E. H. C. Parker, and T. E. Whall, Phys. Rev. E 66, 036705 (2002)

Figure 1

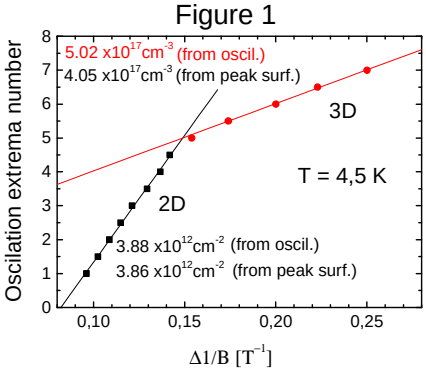

Figure 2