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

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Currently, electronic properties of InN have been a subject of intense studies. After re-evaluation of its energy gap (allowing to extend the wavelength coverage of III-Nitrides to infrared region) it has emerged as a promising candidate for application in high-speed electronic and optoelectronic devices due to the predicted extraordinary electron transport parameters among III-Nitrides. However, InN is still quite mysterious and a lot of effort is needed to understand and to control the electrical processes in this semiconductor. The key problem is its multicarrier/ multichannel conduction. We have studied multicarrier contributions to the conductivity in low concentration non-doped InN layers grown on GaN buffer. We measured magnetic field dependence of resistivity tensor, ρ_{xx}, ρ_{xy} to determine the different contributions to the conductivity, as well as Shubnikov-de Haas oscillations in tilted magnetic fields to identify a character of these contributions. The Mobility Spectrum Analysis [1] has confirmed multicarrier character of the conductivity. In addition to the bulk and surface accumulation layer other contributions to the conductivity has been detected (see Fig. 1). As concerning Shubnikov-de Haas measurements we have: (1) – detected quantum oscillations related to different conduction channels, (2) – found that some of them were related to 2D (see Fig. 2) and others to 3D carriers, (3) – calculated carrier concentrations from the period of oscillations, (4) – evaluated effective masses of the carriers (temperature dependences of the oscillation amplitude were measured). Two-dimensional electron contributions seen in Shubnikov de Haas studies cannot be assigned to the surface electrons as the latter have very low mobility. The values of the effective masses derived from the temperature dependences of oscillations amplitudes, are typical for low concentration InN, thus confirming that these contributions are located on the InN side of the GaN/InN 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

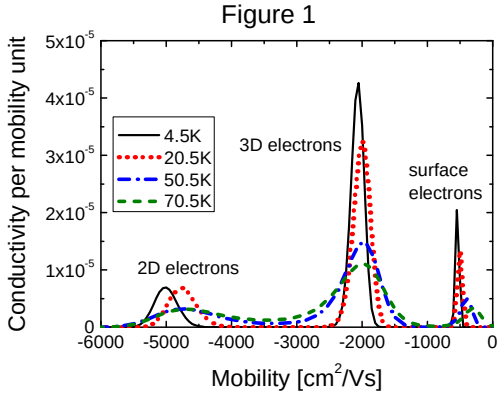

Figure 2