# Effect of High Dislocation Density on Current Transport through Ohmic Contacts to InN

**P. O. Sai [1,2], D. B. But [1], G. Cywiński [1], N. V. Safriuk [2], V. V. Shynkarenko [2], N. S. Boltovets [3]**

*[1] Institute of High Pressure Physics, Polish Academy of Sciences, ul. Sokołowska 29/37, 01-142 Warsaw, Poland*
*[2] Lashkaryov Institute of Semiconductor Physics, National Academy of Sciences of Ukraine, pr. Nauki 41, 03028 Kiev, Ukraine*
*[3] State Enterprise Research Institute "Orion", vul. E. Pottier 8a, 03057 Kyiv, Ukraine*

High defect density is one of key issues in the realization of indium nitride great potential due to epitaxial growth on substrates with a significant mismatch of crystal lattice parameters and thermal expansion coefficient. In its turn, high structural defect density strongly effects on the process of ohmic contact formation, and current transport mechanism through metal/InN interface, explanation of this effect is the main goal of the present work.

For this purpose, three 0.9 μm thick InN films were grown by plasma-assisted molecular beam epitaxy on $Al_2O_3$ substrates. All InN films were preceded with 0.9 μm GaN buffer layer. Our ohmic contacts were performed by the sequential vacuum deposition of Pd(30 nm)/Ti(50 nm)/Au(100 nm) onto InN epitaxial films heated to 350 °C. Here, we have compared results of our transfer length measurement investigations relative to the InN films free electron concentrations $4\cdot10^{19}$ cm$^{-3}$, $8\cdot10^{18}$ and $2\cdot10^{18}$ cm$^{-3}$, for samples A, B and C, respectively (Fig. 1).

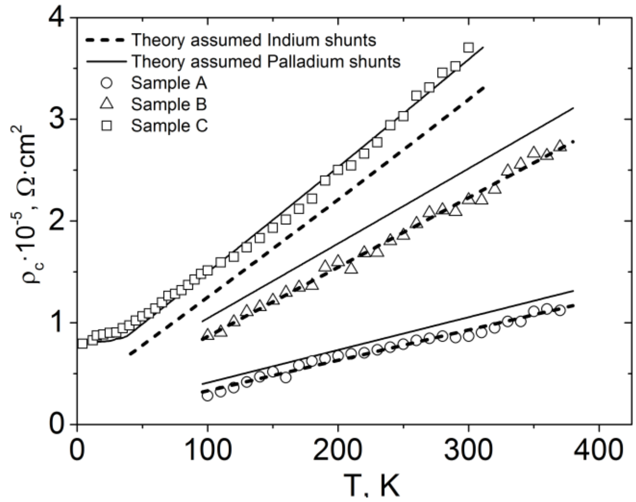

Fig. 1. Temperature dependences of contact resistivity: experiment (symbols) and theory (solid and dash curves).

The unusual growing behavior of temperature dependences of contact resistivity $\rho_c(T)$ was observed for each sample in the entire range of measured temperature from 4.2 to 380 K (Fig. 1). It can't be explained by classical current transport mechanisms. We propose explanation considering the current transport through the metal shunts associated with the so-called conduction dislocations and current limitation by a diffusion mechanism supplying electrons. Theoretical modeling of this mechanism was developed in [1] and experimentally confirmed in case of ohmic contacts to GaAs, InP, GaN [1] and Si [2]. For samples A and B, which were grown with an accumulation of indium on the surface and then confirmed experimentally by Auger profiling, we expect indium penetrates into dislocations. Therefore, we obtained the best agreement of the theory and experimental data, when indium shunts for A and B samples and palladium shunts for C sample were assumed. Additionally, the density of conducting dislocations extracted from theory well agree with experimental values of screw and edge dislocation density obtained by High-Resolution X-Ray Diffraction in case of each investigated samples.

[1] A. Sachenko, A. Belyaev, N. Boltovets, R. Konakova, Y. Y. Kudryk, S. Novitskii, V. Sheremet, J. Li and S. Vitusevich, Journal of Applied Physics **111** (8), 083701 (2012).
[2] A. Sachenko, et al., Journal of Applied Physics 112 (6), 063703 (2012).