Calculations of tunneling currents through nitride p-n junctions within framework of k·p model

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Polarization charges at heterointerface of tunnel junction (TJ) enable obtaining an interband TJ using large-band-gap III-nitride semiconductors. Use of efficient TJ can constitute an effective way of injecting holes into the p-type region of LDs and LEDs overcoming the obstacle of poor conductivity of p-type regions of nitride devices. This gives possibility for new architectures of these devices to be developed.

To understand properties of semiconductor devices containing an interband tunnel junction, the knowledge of physical transport phenomena occurring through the TJ is important. Conventional methods of calculating transmission coefficients using semiclassical model of triangular barrier cannot be reliable enough, concerning various quantum effects occurring at the interface of the TJ.

In this work we expand multiband treatment of InGaN based TJs by applying 8-band ***k·p*** model for wurtzite semiconductors proposed by Chuang and Chang [1] within framework of the multiband quantum-transmitting boundary method (MQTBM) developed by Liu, Ting and McGill [2]. We discuss results of MQTBM calculations for GaN:Si/InGaN/GaN:Mg polarization charge nitride tunnel junctions. The transmission coefficients and current-voltage characteristics are studied as a function of the doping level and the InGaN well composition and well width.

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