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Investigation of the electronic transport in polarization-induced nanowires using conductive atomic force microscopy (AFM) CAMELIA SELCU, SANTINO C. CARNEVALE, THOMAS F. KENT, FATIH AKYOL, PATRICK J. PHILLIPS, MICHAEL J. MILLS, SIDDHARTH RAJAN, JONATHAN P. PELZ, ROBERTO C. MYERS, The Ohio State University —
In the search to improve short wavelength light emitting diodes (LED's), where the dislocations limit their performance and hole doping (Mg) is a fundamental challenge, the III-Nitride polarization-induced nanowire LED provides a promising system to address these problems. The new type of pn diode, polarization-induced nanowire LED (PINLED), was developed by linearly grading AlGaN composition of the nanowires (from GaN to AlN and back to GaN) from 0% to 100% and back to 0% Al (Carnevale et al, *Nano Lett.*, **12**, 915 (2012)). In III-Nitrides (Ga,Al/N), the effects of polarization are commonly observed at the surfaces and interfaces. Thus, in the case of the polarization-induced nanowire LEDs, taking advantage of the bound polarization charge, due to the grading of the AlGaN, the pn diodes are formed. The polarity of the nanowires determines the carrier type in each graded region, and therefore the diode orientation (n/p vs p/n). We used conductive AFM to investigate polarity of the PINLED's as well as hole conductivity in PINLED's made of AlGaN with and without acceptor doping. The results reveal that most of the wires are n-top/p-bottom (N-face), but some are p-top/n-bottom (Ga-face). Also, we found that the current density is 3 orders of magnitude larger in the case of the doped nanowires than the nanowires with no impurity doping.

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