Electrical Contacts to β-Ga_2O_3

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Abstract: Ultrawide band gap semiconductors have been of great interest due to their favorable properties including high saturation carrier velocity and low intrinsic carrier concentration for many applications, such as in high power and fast switching devices that can survive in extreme environments. One of these semiconductors of interest is beta gallium oxide (β-Ga_2O_3), which in addition to its ultrawide bandgap, also has a wide range of shallow n-type dopants (Si, Sn, Ge) and can be grown from the melt. A key step in the device fabrication process for these applications is the metal-semiconductor interface and its behavior. The first aim of the research presented is to analyze structural defects and their impact on electrical performance in (010) β-Ga_2O_3. Pt Schottky contacts were fabricated on structural "nanopipe" defects and analyzed through Current-Voltage (I-V), Current-Voltage-Temperature (I-V-T), and Capacitance-Voltage (C-V) measurements. Parameters such as the ideality factor (n), Schottky barrier height (ϕ_B), and the donor concentration (N_D) were determined to assess the impact of structural defects on overall device performance. The second goal of the research was to analyze the stability of Pt Schottky contacts for high power and high temperature applications. This was accomplished with I-V and C-V measurements after annealing the contacts at temperatures up to 700 °C. In conjunction with I-V and C-V measurements after various annealing temperatures, Pt/β-Ga2O3 cross-section samples have been prepared for transmission electron microscopy analysis.