Open-gated ph sensor fabricated on an undoped-algan/gan hemt structure

Abstract:

The sensing responses in aqueous solution of an open-gated pH sensor fabricated on an AlGaN/GaN high-electron-mobility-transistor (HEMT) structure are investigated. Under air-exposed ambient conditions, the open-gated undoped AlGaN/GaN HEMT only shows the presence of a linear current region. This seems to show that very low Fermi level pinning by surface states exists in the undoped AlGaN/GaN sample. In aqueous solution, typical current-voltage (I-V) characteristics with reasonably good gate controllability are observed, showing that the potential of the AlGaN surface at the open-gated area is effectively controlled via aqueous solution by the Ag/AgCl gate electrode. The open-gated undoped AlGaN/GaN HEMT structure is capable of distinguishing pH level in aqueous electrolytes and exhibits linear sensitivity, where high sensitivity of 1.9 mA/pH or 3.88 mA/mm/pH at drain-source voltage, VDS = 5 V is obtained. Due to the large leakage current where it increases with the negative gate voltage, Nernstian like sensitivity cannot be determined as commonly reported in the literature. This large leakage current may be caused by the technical factors rather than any characteristics of the devices. Surprisingly, although there are some imperfections in the device preparation and measurement, the fabricated devices work very well in distinguishing the pH levels. Suppression of current leakage by improving the device preparation is likely needed to improve the device performance. The fabricated device is expected to be suitable for pH sensing applications.