Dependence of Schottky Diode Hydrogen Sensing characteristics on GaN Crystal Planes

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Response of GaN Schottky diodes to hydrogen was investigated. GaN with hexagonal wurtzite structure has various crystal planes including semipolar (11-22), nonpolar a-plane (11-20) and m-plane (1-100), and c-plane Ga-polar (0001) and N-polar(000-1). We found that the surface atomic configuration and polarity play significant roles in hydrogen sensing. Atomic polarity, density, configuration, and bonding state are determining factors of hydrogen sensing in GaN, where various GaN crystal planes show their unique properties. Schottky diode hydrogen sensors were fabricated on nopolar, semipolar, and polar crystal plane GaN substrates. Each plane exhibits different hydrogen sensing characteristics. For instances, the peak current changes in percentage of c-plane N-polar, a-plane, and semipolar diodes are of the order of 106, while only 80 for the conventional c-plane Ga-polar. This is attributed to the active nitrogen atoms on the GaN surface which have strong affinities for hydrogen atoms.