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The effects of the interfacial layer with interface states on controlling the electronic properties of Au/n-GaAs Schottky diode

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Abstract

The electrical characteristics and interface state density properties of Au/insulator/n-GaAs (MIS metal-insulator semiconductor) diodes with insulator layers having different thickness have been analyzed by current-voltage and capacitance-voltage techniques at room temperature. The barrier height and ideality factor values for MIS Schottky diodes were found to be 0.66 eV, 1.67 and 0.86 eV, 3.75, respectively. The diodes show a non-ideal I-V behavior with the ideality factor greater than unity. This behavior is attributed to the interfacial insulator layer and the interface states. The obtained results show that the insulator layer modifies the electrical parameters such as interface state density, series resistance and reduces the reverse bias leakage current by more than two orders of magnitude. In addition, the interface distribution profiles (D-it) were extracted from the I-V measurements by taking into account the bias dependence of the effective barrier height for the Schottky diode. The energy distribution curves of the interface states of each sample were determined. The interface state density N_{ss} of the diodes was changed from 4.7x10⁽¹²⁾ eV(-1) cm(-2) in (Ec-0.647) eV to 6.35x10⁽¹⁴⁾ eV(-1) cm(-2) in (Ec-0.619) eV for the initial sample AuD1 MIS diode and from 2.67x10⁽¹⁵⁾ eV(-1) cm(-2) in (Ec-0.850) eV to 1.01x10⁽¹⁵⁾ eV(-1) cm(-2) in (Ec-0.756) eV for AuD2 MIS diode.

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