Reversible barrier height changes in hydrogen-sensitive Pd/GaN and Ni/GaN diodes

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GaN grown on silicon (Si) substrates based sensors are still at it infancy due to the poor GaN crystal quality. However, since GaN/Si is cheaper than GaN grown on sapphire, larger Si wafer size and the possibility to integrate other GaN-based optoelectronic devices with Si-based electronic technology, we report here first attempt to fabricate Pd/n-GaN and Ni/n-GaN metal-semiconductor-metal (MSM) photodiode grown on Si by electron cyclotron resonance (ECR) plasma-assisted metalorganic chemical-vapour deposition (MOCVD). Pd and Ni film were deposited using normal thermal evaporation. Formation of Schottky contact on n-GaN was achieves by annealing for sample at 600°C for 1 hour. The forward current of Pd/GaN and Ni/GaN Schottky diodes is found to increase significantly upon introduction of H_2 into a N_2 ambient. Analysis of the current-voltage characteristics as a function of temperature showed that the current increase was due to a reduction in effective barrier height probably caused by a decrease in metal work function upon absorption of hydrogen. The introduction of 2 percent H_2 into a N_2 ambient was found to lower the effective barrier height of Pd on GaN by 70÷160 meV over the temperature range of 25 to ∼325°C and that of Ni on GaN by 90÷170 meV over the range of 170 to ∼400°C. The magnitude of the changes increased with temperature due to the high diffusivity of H_2 into the sample as observed by other researcher on Pt/GaN. The changes in barrier height were completely reversible upon restoration of N_2 ambient.

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