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A comparison of solid state reaction, electrical performance and failure mechanism of ruthenium Schottky contacts on 6H-SiC and 4H-SiC after air annealing.

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Abstract content
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Thin films of ruthenium (Ru) on 6-hexagonal silicon carbide (6H-SiC) and 4-hexagonal silicon carbide (4H-SiC) were analysed by Rutherford backscattering spectroscopy (RBS) at various annealing temperatures. Some thin film samples were also analysed by Raman spectroscopy and x-ray diffraction (XRD) technique. RBS analysis indicated ruthenium oxidation at a temperature of 400 C and commencement of diffusion of Ru into SiC at a temperature of 500 C for both Ru-4H-SiC and Ru-6H-SiC. X-ray diffraction analysis of samples annealed in air at 600 C showed evidence of formation of ruthenium silicide in both 4H and 6H-SiC but this was not corroborated by RBS analysis. Silicide formation in 4H-SiC and Ru oxidation in 6H-SiC were also confirmed by Raman analysis. The fabricated Ru-6H-SiC and Ru-4H-SiC Schottky barrier diodes (SBD) with nickel ohmic contacts showed excellent rectification behaviour and linear capacitance-voltage characteristics up to an annealing temperature of 600oC for 6H-SiC and 300 C for 4H-SiC . The Ru-6H-SiC and Ru-4H-SiC SBDs degraded after annealing at 700 oC and 400 C respectively as evidenced by the appearance of infinite series resistance. The degradation of Ru-6H-SiC is attributed to the inter-diffusion of Ru and Si at the Schottky-substrate interface, while the oxidation of Ru which led to the formation of of non-conducting and gaseous oxide compounds is the cause of Ru-4H-SiC SBDs device failure.

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