Interconnect Copper Metallization of InGaP HBTs Using WN_X as the Diffusion Barrier

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Interconnect copper metallization of InGaP HBTs using WN_X as diffusion barrier was studied. The WN_X (40 nm) and Cu (200nm) films were deposited sequentially on the InGaP HBT wafers as the interconnect metallization layers using sputtering method. X-ray diffraction (XRD) and Auger electron spectroscopy (AES) showed that the Cu/WN_X/ohmic interface and Cu/WN_X/SiN interface were very stable after high temperature annealing. The I-V curve of the HBT with Cu metallization has a higher saturation current than the HBT with Au matallization. To test the reliability of the Cu metallized HBT, it was bias with Vce=3 V, Jc=125 kA/cm^2 for 15 hours. The current gain (β) of GaAs HBT shows no degradation and is still higher than 100 after the high current density stress for 15 hours. From the electrical measurement, the XRD and the AES analysis, WN_X demonstrated to be a good diffusion barrier for Cu in GaAs device and the Cu/WN_X films can be used for the interconnection copper metallization for GaAs HBTs.

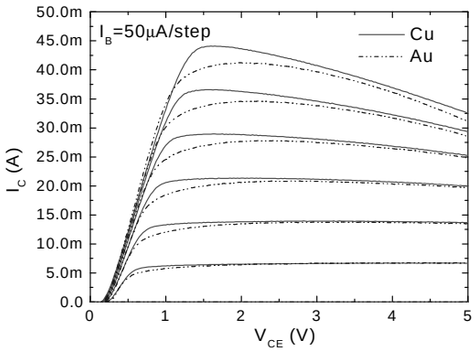

Fig. 1. Comparison of typical I_C-V_{CE} characteristics for a small emitter (3x20 μm^2) HBT with Cu and Au interconnect metallization

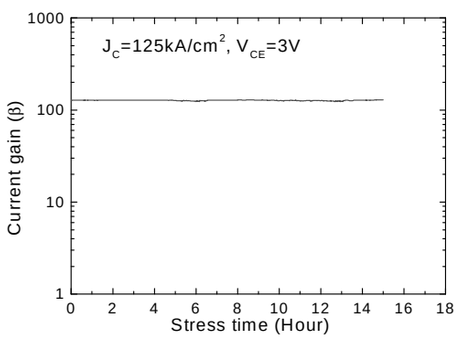

Fig. 2. Reliability test for the Cu metallized HBT at high current density J_C=125 kA/cm^2 and V_{CE}=3V. The device shows no degradation after 15 hours.