TiW-based InP DHBT technology for next generation communication systems analog front-end integrated circuits

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Indium Phosphide (InP) double heterojunction bipolar transistors (DHBTs) have enabled the realization of very-high performances >100-GHz wireless and >100-Gbaud optical transceivers' analog-front-end integrated circuits (ICs) [1, 2]. To further improve the operating frequencies while handling large output power, DHBTs with TiW emitter are an attractive path towards THz technologies [3]. We report a high-yield TiW-based InP-DHBT technology used to realize high-performance linear driver and analog-multiplexer (AMUX)-driver ICs.

The InP DHBT structure and process are similar to [4, 5] except for a 20% thinner base, drastically shrunk emitter layers and the use of a TiW-based emitter metal stack with SiN sidewalls (Fig.1). The obtained fabrication yield on the 3-inch wafer (>98%) is similar to our reference process [5].

The 0.4×5-μm² DHBTs' peak current gain is >40 and the base and collector ideality factors are 1.36 and 1.09, respectively (Fig.2). The devices exhibit a 4.2-V breakdown voltage BVCE0 at a 0.03-mA/μm² collector current density, JC, (Fig.3). Peak fT/fMAX, extracted from on-wafer S-parameter measurements up to 110 GHz, are above 400/520 GHz, respectively, at VCE=1.6V and a JC~6mA/μm² (Fig.4). The linear driver and AMUX-driver [2] implemented in this technology are composed of 22 and 76 DHBTs, respectively, and show high IC yield (Fig.5). They demonstrate PAM-4 output swings of 3.2-Vppd at 64-GBd and 2.3-Vppd at 100-GBd, respectively, with clear eye-opening (Fig.6).

This TiW-based technology will enable <0.4-μm-emitter-width DHBTs with reduced base-link resistance for higher frequency performances.