Abstracts

Base-profile optimization for minimum noise figure in advanced UHV/CVD SiGe HBT's

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We investigate the base-profile design issues associated with optimizing ultrahigh vacuum/chemical vapor deposition (UHV/CVD) silicon-germanium (SiGe) heterojunction bipolar transistors (HBT's) for minimum broad-band noise. Using the simulator for cryogenic research and SiGe bipolar device optimization (SCORPIO), the impact of Ge profile, base doping level, and base thickness on minimum noise figure (NF/sub min/) are quantitatively examined across the -55/spl deg/C-125/spl deg/C temperature range. We introduce a novel Ge profile for optimum NF/sub min/, which allows independent control of current gain (/spl beta/) and achieves maximum f/sub T/ while maintaining thermodynamic stability. Simulations show that this profile can achieve a /spl beta/ of /spl sim/200, a peak f/sub T/>50 GHz, a peak f/sub max/>60 GHz, and an NF/sub min/<0.5 dB at 2 GHz and <1 dB at 10 GHz using a conservative base width of /spl sim/90 nm. We predict that a 45-nm base-width/0.5-/spl mu/m emitter-width device with a thermodynamically stable flat Ge profile, manufacturable using an UHV/CVD growth technique, should be able to achieve an NF/sub min/<0.4 dB at 2 GHz and /spl sim/0.8 dB at 10 GHz along with a /spl beta/ of /spl sim/300, a peak f/sub T/>70 GHz, and a peak f/sub max/>90 GHz. These 300-K performance values improve as the temperature is reduced.

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