136
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Title:Physical and electrical performance limits of high-speed SiGeC HBTs- Part I: Vertical scaling
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Abstract:The overall purpose of this paper (including Part I, in this issue) is the prediction of the ultimate electrical high-frequency performance potential for SiGeC heterojunction bipolar transistors under the constraints of practical applications. This goal is achieved by utilizing most advanced device simulation tools with parameters calibrated to existing experimental results. This Part I outlines the overall scaling procedure and then focuses on the vertically scaled structure. According to isothermal device simulation, the "ultimate" doping profile yields a peak transit frequency fT of almost 1.5 THz, a BVCEO above 1 V (dependent on BE bias) and a zero-bias internal base sheet resistance of about 3 kΩ/sq. The reasons for achieving a higher product fTBVCEO (>1.5 THzV}) than anticipated from the classical Johnson limit are explained. Finally, it is found that f T is limited by the minority charge stored in the BE junction and that BVCEO is mainly determined by the tunneling mechanisms in the base-collector space-charge region.
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