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VBIC Model Application and Model Parameter Optimization for SiGe HBT

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bstract **This paper applies VBIC model for SiGe HBT device and seeks an efficient methodology to extract and optimize all the DC and AC parameters of the VBIC model. Especially, s-parameter fitting is performed in optimum bias point considering speed and power. Simulated results by the optimized VBIC model parameter are compared with the measurement data and show very good agreement in both DC and s-parameters prediction.**

In this paper, the parameter extraction and optimization method of the VBIC model is discussed for SiGe HBT. The procedure of VBIC model parameter extraction and optimization we have developed for SiGe HBT follows the flowchart of fig. 1.

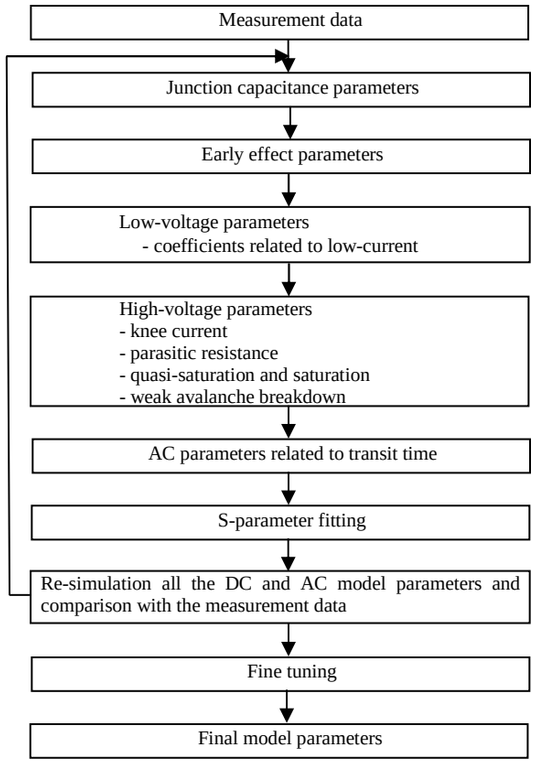

Fig. 1. Flowchart for VBIC model parameter extraction and optimization of SiGe HBT.

Especially, in this paper, the methods of AC parameter extraction and s-parameter fitting are summarized as follow. Firstly (f_T-I_C curve fitting), since Region I of fig. 2 is dominated by depletion capacitance, initial depletion capacitance parameters optimized in previous step are optimized again, in Region I, to exactly fit f_T-I_C curve and s-parameters. Secondly (parameter optimization associated with transit time), AC parameters associated with transit time are extracted mainly, in Region II of f_T-I_C curve of fig. 2. Finally (s-parameter fitting), as some parameters are voltage-dependent and/or current-dependent (or not linear), s-parameter fitting cannot be done satisfyingly in all the bias points. Because of this reason, s-parameter fitting is performed in specific bias point, i.e. optimum bias point considering speed and power indicated in fig. 2. Fig. 3 shows small-signal s-parameters, S11, S21, S12, S22 traces under V_{CE}=1.0V, I_C=1mA for SiGe HBT. For DC optimization, average error between measurement and modeled results was below 15 % and for AC s-parameter optimization, average error between measurement and modeled results was below 5 %. As a result of these, the simulation results were in very good agreement with the measurement data. We can conclude that the extraction and optimization methodology of this paper is very adequate for modeling SiGe HBT, using the VBIC model.

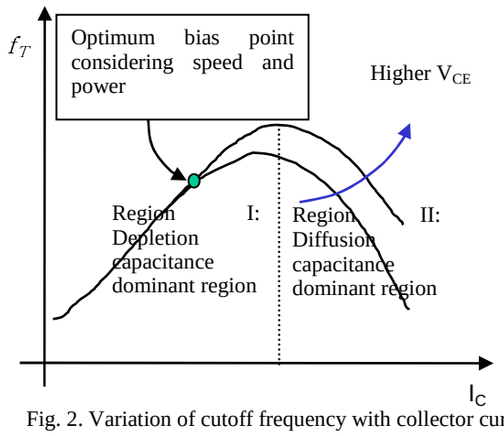

Fig. 2. Variation of cutoff frequency with collector current.

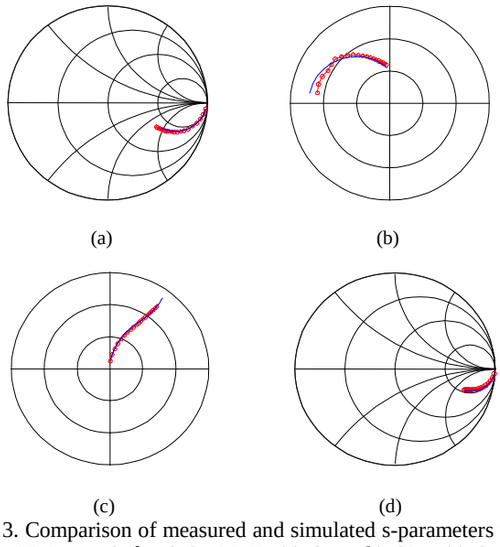

Fig. 3. Comparison of measured and simulated s-parameters under V_{CE}=1V, I_C=1mA for SiGe HBT. (a) S11, (b) S21, (c) S12, (d) S22. (circle: measured, line: simulated)

REFERENCES

[1] S.-Y. Lee, et al, “The behavior of Ti silicidation on Si/SiGe/Si base and its effect on base resistance and fmax in SiGe hetero-junction bipolar transistors”, *Journal of Materials Science: Materials in Electronics*, vol. 12, no. 8, pp. 467-472, August 2001.