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Accession Number

12287982

Author

Koswatta SO. Valdes-Garcia A. Steiner MB. Yu-Ming Lin. Avouris P.

Author Unabbreviated

Koswatta S. O.; Valdes-Garcia A.; Steiner M. B.; Avouris P.

Author/Editor Affiliation

Koswatta SO. Valdes-Garcia A. Steiner MB. Yu-Ming Lin. Avouris P. : IBM T. J. Watson Research Center, Yorktown Heights, NY 10598, USA

Title

Ultimate RF Performance Potential of Carbon Electronics

Source

IEEE Transactions on Microwave Theory and Techniques, vol.59, no.10, pt.2, Oct. 2011, 2739-50. Publisher: IEEE, USA.

Abstract

Carbon electronics based on carbon nanotube array field-effect transistors (AFETs) and 2-D graphene field-effect transistors (GFETs) have recently attracted significant attention for potential RF applications. Here, we explore the ultimate RF performance potential for these two unique devices using semiclassical ballistic transport simulations. It is shown that the intrinsic current-gain and power-gain cutoff frequencies (fT and f_{MAX}) above 1 THz should be possible in both AFETs and GFETs. Thus, both devices could deliver higher cutoff frequencies than traditional semiconductors such as Si and III-V's. In the case of AFETs, we show that their RF operation is not sensitive to the diameter variation of semiconducting tubes and the presence of metallic tubes in the channel. The ultimate fT and f_{MAX} values in AFETs are observed to be higher than that in GFETs. The optimum device biasing conditions for AFETs require smaller biasing currents, and thus, lower power dissipation compared to GFETs. The degradation in high-frequency performance in the presence of external parasitics is also seen to be lower in AFETs compared to GFETs. (62 References).