A Dual Sweep Transfer Curve Technique for Separate Extraction of Source and Drain Resistances in Advanced FETs without Substrate Contacts

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Layout asymmetry, processing, and hot-carrier stress may cause asymmetric source (R_S) and drain (R_D) parasitic resistances in FETs. This asymmetry has invalidated many conventional methods due to incorrect assumption of $R_D = R_S$ for the extraction of device parameters [1]. Separate characterization of R_S from R_D is important in the accurate and systematic design through performance estimation and characterization of physics-related reliability mechanisms. In particular, accurate separate extraction of R_S and R_D in SOI MOSFETs is important in the modeling and characterization for practical applications. In this work, we present a convenient technique to extract R_S and R_D separately. The method, so called a dual sweep transfer curve technique, is based on the I-V models in the linear region of MOSFET's. In this technique, transfer characteristics for both forward and reverse modes in a single SOI MOSFET are employed. Experimentally extracted R_S and R_D are confirmed to be insensitive to the variations of the effective channel length, width, and mobility under the gate bias, minimizing the resistance errors generated from those parameters. The proposed technique provides a high accuracy and also, unlike other method [2], allows fast characterization in substrate contactless field effect transistors.
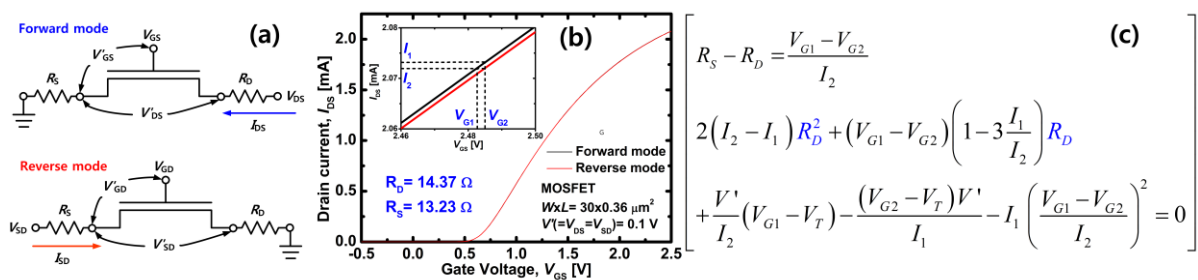
Fig 1. (a) The equivalent circuit model of SOI MOSFET, (b) forward and reverse mode characteristics in linear current-voltage graph and (c) The equations for the separate extraction of R_S and R_D.

[1] G. J. Hu, C. Chang, and Y.-T. Chia, IEEE TED, vol. ED-34, p. 2469(1987)

[2] Ja Sun Shin, Hagyoul Bae, Euiyoun Hong, Jaeman Jang, Daeyoun Yun, Jieun Lee, Dae Hwan Kim, and Dong Myong Kim, SSE, 72, p.78(2012)