Large-Signal SPICE-compatible Metal-Insulator-Graphene-Diode Model on a Flexible Substrate for RF/Microwave Application

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Abstract

A metal-insulator-graphene (MIG) diode is reported in [1] on a rigid substrate and a microwave MIG diode power detector is demonstrated in [1][2]. The main advantage of a MIG diode is higher asymmetry compared to a metal-insulator-metal (MIM) device. Moreover, MIG diodes can be transferred on different substrates due to the thin-film process and show a substrate independent performance. Based on the concept, a flexible MIG diode is fabricated and modelled. It is realised on a 50 μm-Kapton substrate based on graphene material grown by chemical vapor deposition (CVD) and TiO_2 as a barrier material. The flexible MIG diode has several superior properties compared to a diode using flexible Si, carbon-nanotube (CNT) or ZnO especially for microwave application. Besides, it is important to build a model for circuit design and optimisation. A SPICE-compatible model is thus demonstrated. To acquire the intrinsic parameters, *e.g.*, the series resistance, the Lambert W-function [3] is employed. The equivalent circuit model is verified up to 20 GHz. This work shows that the SPICE model can successfully predict the behaviour of MIG diodes.

References

[1] M. Shaygan et al, Nanoscale, 9 (2017) page 11944—11950
[2] M. Saeed et al, T-MTT, 4 (2018) 2018--2024
[3] T. C. Banwell and A. Jayakumar, Electronics Letter, 4 (2000) 291-292

Figures

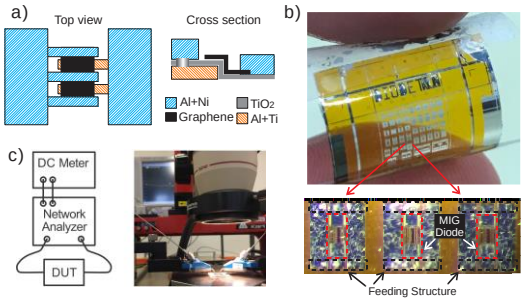

Figure 1: a)Cross section of the MIG diode, (b)photograph, and (c)measurement setup

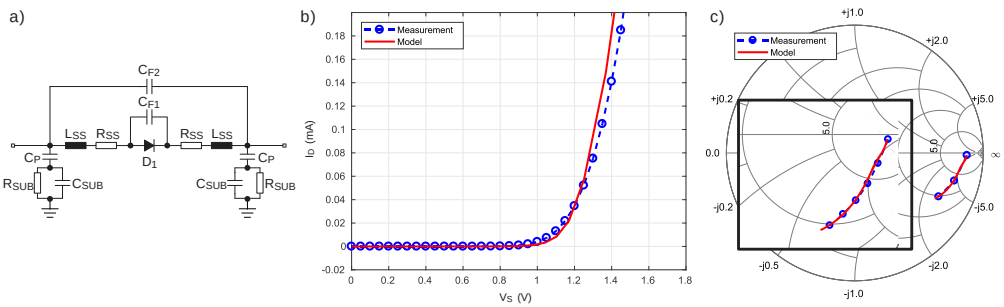

Figure 2: a) Equivalent circuit model, b) measured and modelled DC IV curves and c) S_{11}.