Large-Signal Model of Tellurium-Metal (TM) Diode for RF Applications

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Abstract

Tellurium-metal (TM) diodes have demonstrated strong potential for high performance RF applications [1], [2]. They have already outperformed other 2D material-based devices, even those at a more mature technological stage, in nonlinear applications such as power detection [1]. To accurately simulate circuits that exploit the nonlinearity of 2D tellurium diodes, a physics-based large-signal description is essential.

In this work, we develop a physics-based large-signal compact model for TM diodes. The model is implemented in Verilog-A to ensure compatibility with standard circuit simulators and is validated against DC and S-parameter measurements of fabricated TM diodes, demonstrating excellent agreement.

Furthermore, the model is benchmarked against an experimental TM diode operating as a power detector, demonstrating its predictive capability and suitability for RF circuit design.

References

[1] Palacios, P., Askar, A. M., Pasadas, F., Saeed, M., Marin, E. G., Adachi, M. M., & Negra, R. (2024). Dielectric-doped 2D tellurium diodes for zero-bias radio frequency power detection. *Advanced Electronic Materials,* 10(11).

[2] Askar, A. M., Palacios, P., Pasadas, F., Saeed, M., Mohammadzadeh, M. R., Negra, R., & Adachi, M. M. (2023). Two-dimensional tellurium-based diodes for RF applications. *npj 2D Materials and Applications*, 7(1).

Figures

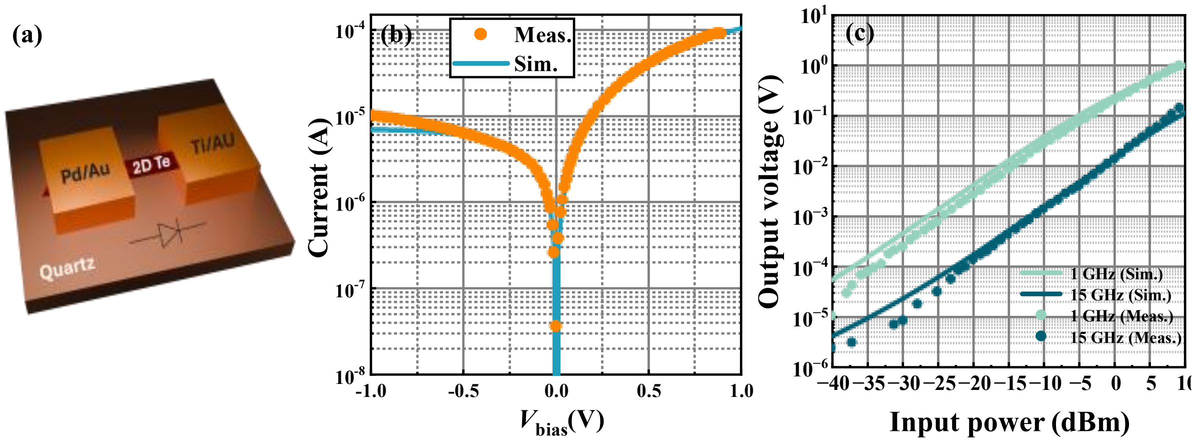

Figure 1: (a) Cross section of the Schottky Te-metal (TM) diode; (b) Simulated (blue solid lines) and measured (orange symbols) I–V characteristic curve of the TM diode; (c) simulated output DC voltage as a function of RF input power for the TM diode.

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