Analysis of the low temperature behavior of GaN-on-SiC Schottky barrier diodes

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***Abstract*—GaN-on-SiC Schottky Barrier Diodes have been characterized from 33 to 475 K. A theoretical model accounting for image force lowering is used to extract the parameters of the diodes and predict the reverse-bias current. Deviations from the ideal behavior are observed for low temperatures both in forward and reverse bias.**

***Keywords*—GaN Schottky barrier diodes, low temperature characterization.**

I. Introduction

In the last years, GaN has attracted great interest for the fabrication of Schottky Barrier Diodes (SBDs) for high-frequency high-power applications [1], such as frequency multipliers in the sub-THz range overcoming the power output performance of the standard GaAs technology [2]. The potential use of GaN SBDs in systems for space applications motivates the study of the diodes at cryogenic temperatures reported in this work.

II. Results

C-V and *I-V* measurements were carried out from 33 to 475 K on a (221 μm diameter) GaN-on-SiC SBD fabricated at IEMN. *C-V* measurements provide an epilayer doping level of 1.05×10^{17} cm^{-3}, used for the fitting of the *I-V-T* curves shown in Fig. 1(a), from which the barrier height and the ideality factor were extracted (inset). A thermionic-emission (TE) model including image force lowering and series resistance (around 10 Ω for all *T*) was used. In Fig. 1(a), the expected decrease of the TE current when lowering *T* is observed, jointly with a non-ideal current mechanism preventing a good fitting of the *I-V* curves at the lowest temperatures, confirmed by the decrease of the barrier height and increase of the ideality factor (inset). Indeed, a kink in the *I-V* curves appears at low *T*, which could be attributed to the presence of defects or inhomogeneities in the barrier.

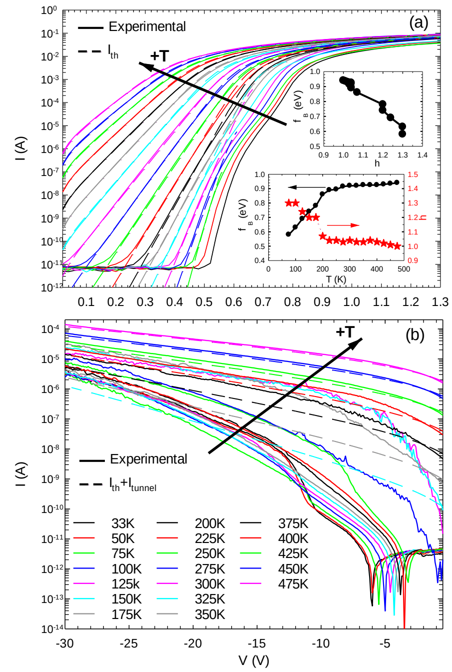

Fig. 1. Comparison of the (a) forward- and (b) reverse-bias *I-V-T* characteristics obtained experimentally (solid lines) and with the model (dashed lines). Insets: barrier height and idelity factor vs. *T*.

For reverse bias, Fig. 1(b), our model, which includes also the tunneling current (using the same barrier height as in forward-bias), correctly fits the measurements for the highest temperatures. However, below 400 K other tunneling current mechanisms become significant.

References

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