Highlights

ACTIVITY E Advanced materials and techniques for organic electronics, biomedical and sensing applications 2020

Macroscopic Versus Microscopic Schottky Barrier Determination at (Au/Pt)/Ge(100): Interfacial Local Modulation

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Macroscopic current–voltage measurements and nanoscopic ballistic electron emission spectroscopy (BEES) have been used to probe the Schottky barrier height (SBH) at metal/Ge(100) junctions for two metal electrodes (Au and Pt) and different metallization methods, specifically, thermal-vapor and laser-vapor deposition. Analysis of macroscopic current–voltage characteristics indicates that a SBH of 0.61–0.63 eV controls rectification at room temperature. On the other hand, BEES measured at 80 K reveals the coexistence of two distinct barriers at the nanoscale, taking values in the ranges 0.61–0.64 and 0.70–0.74 eV for the cases studied. For each metal–semiconductor junction, the macroscopic measurement agrees well with the lower barrier found with BEES. Ab initio modeling of BEES spectra ascribes the two barriers to two different atomic registries between the metals and the Ge(100) surface, a significant relevant insight for next-generation highly miniaturized Ge-based devices.

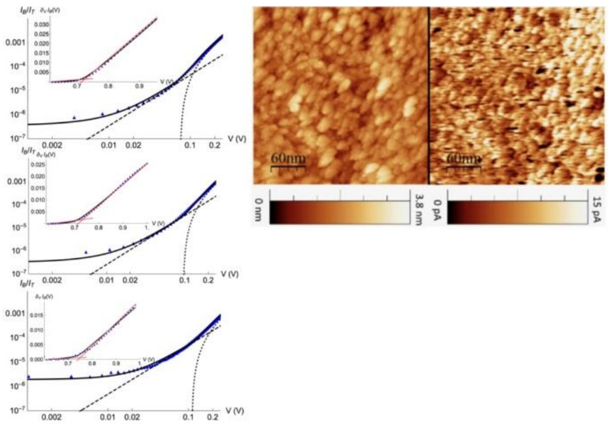

Fig. 1: (left panel) Experimental BEES data (blue triangles, T=80K) for the three different samples: top panel (Au-PLD, I_T=2:5nA), middle panel (Au-PVD, I_T=2 nA), lower panel (Pt-PLD, I_T=3nA). The origin of each Log-Log plot corresponds to the lowest barrier for each case. Black thick line: best fit from theoretical model derived from an ab-initio calculation at T=80K. Black dashed and dotted lines give the individual contributions of each barrier at T=0K. Insets: a comparison of derivatives for experimental data and best fits (black line).
(right panel) Representative images for topography and the related BEEM current map acquired over a representative region (300x300 nm^2) of the Au electrode at 80 K.