Investigation of Heat Transport in an Individual Nanostructure by Dual Scanning Electron and Thermal Microscopies

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Abstract
A novel combined setup, with a Scanning Thermal Microscope [1] (SThM) embedded in a Scanning Electron Microscope [2] (SEM), is used to characterize a suspended silicon rough nanowire, which is epitaxially clamped at both sides and therefore monolithically integrated in a microfabricated device [3]. The rough nature of the nanowire surface, which prohibits vacuum-SThM due to loose contact for heat dissipation, is circumvented by decorating the wire with periodic platinum dots. Reproducible approaches over these dots, enabled by the live feedback image provided by the SEM, yielded a strong improvement in thermal contact resistance and a higher accuracy in its estimation. The results – thermal resistance at the tip-sample contact of 188 ±3.7 K/W and thermal conductivity of the nanowire of 13.7 ±1.6 W/m·K – are obtained by performing a series of approach curves on the dots [4]. The work highlights the capabilities of the dual SThM/SEM instrument, in particular the interest of systematic approach curves with well-positioned and monitored tip motion.

References

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[3] Sojo-Gordillo, J. M.; Estrada-Wiese, D.; Duque-Sierra, C.; Gadea Diez, G.; Salleras, M.; Fonseca, L.; Morata, A.; Tarancon, A., Adv. Materials Technologies, 7, (2022), 2101715.

Figures

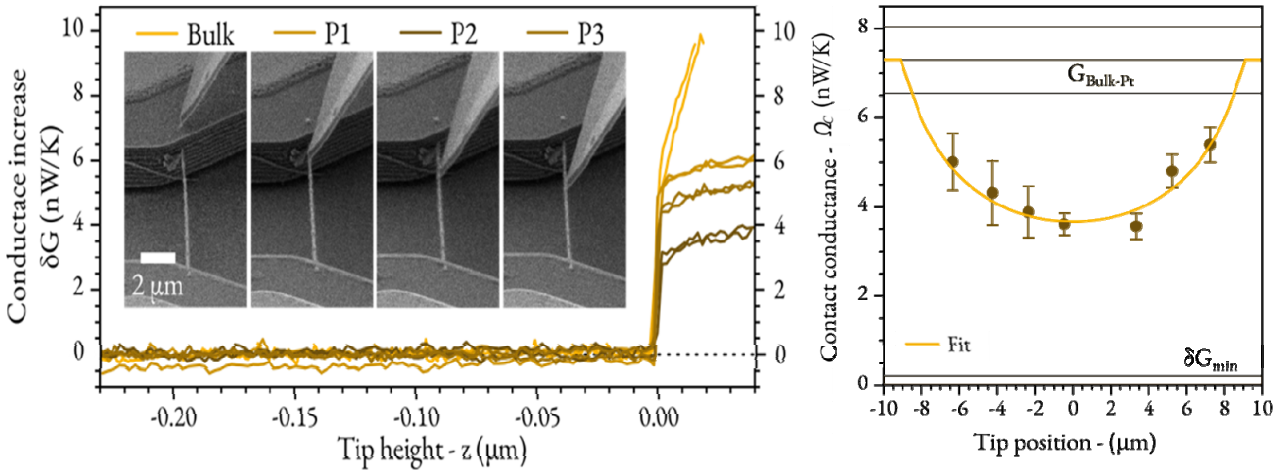

Figure 1: Thermal conductance increase vs. tip height z for approaches over different deposited Pt nanodots along Si NW (on the left) and in contact with the measured nanowire at different locations along the nanowire (on the right).