Nanoscale Measurement of Thermal Conductivity of Organic and Inorganic Nanowires embedded in a matrix.

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In this abstract, we present thermal conductivity measurements of inorganic and organic nanowires. These measurements have been carried out with a Scanning Thermal Microscope (SThM) working in 3ω mode. This technique has been proved to be a successful method to evaluate the thermal conductivity of single nanowires without the need of removing the matrix at which they are embedded. On the one hand, regarding inorganic nanowires, a thermal conductivity of 1.37±0.20W/m·K have been determined for nanowires made of Bi_2Te_3 with 350nm diameter [1]. On the other hand, measurements of the thermal conductivity of polymeric nanowires made of P3HT embedded in a matrix have been studied in dependence with the diameter of the nanowire. In this work, a reduction of the thermal conductivity of the nanowire is observed as its diameter becomes lower, which can be correlated with its different polymer crystalline orientations [2]. The thermal conductivity of the nanowires varies drastically from 2.29±0.15W/m·K to 0.5±0.24W/m·K when the diameter of the P3HT nanowire is reduced from 350nm to 120nm [2]. Moreover, a finite element model with COMSOL was also developed to validate the results of the thermal conductivity of the nanowires obtained from the analysis of the 3ω signal of the thermal probe and the use of the effective medium theory. The 3ω-SThM technique is a powerful technique to determine the thermal properties of individual nanowires and study how this property changes in comparison to bulk structures or as a dependence of its diameter size, among others.

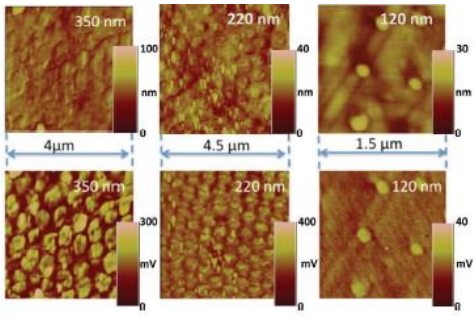

Figure 1: Topographic and Thermal images of organic P3HT Nanowires with different diameters.

References:

[1] M. Muñoz-Rojo, S. Grauby, J. M. Rampnoux, O. Caballero-Calero, M. Martin-Gonzalez, S. Dilhaire, Journal of Applied Physics 2013, 113, 054308.
[2] M. M. Rojo, J. Martin, S. Grauby, T. Borca-Tasciuc, S. Dilhaire, M. Martin-Gonzalez, Nanoscale 2014, 6, 7858.