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General One step dry method for the synthesis of supported single-crystal organic nanowires and 1D heterostructures: perylenes, porphyrins and phthalocyanines

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In this communication we present a general one step method for the growth of supported perylene, porphyrin and phthalocyanine single-crystalline nanowires. The successfully deposition of high-density arrays of semiconductor nanowires on metal nanoparticles and different oxide thin films by a vapor transport process is shown. High quality nanowires with squared footprint and belt shape grow with a homogeneous cross section from the substrate (c.f. Figure 1) [1]. The HRTEM and ED results demonstrate that the nanowires are form by columns of molecules showing a Pi-Stacking along the column axe and a herringbone arrangement with a tilt angle of "15º or 30°" between those [2]. This one step dry method presents significant advantages over other solution and template methodologies such its simplicity, mild conditions, relative low substrate temperature, as well as the high homogeneity and crystallinity of the nanowires synthesized (Fig. 1 c). In addition, the nanowires grown by this method are in solid contact with the substrate (metal nanoparticle or oxide thin film). The universal character of the process for different types of molecules allows the fabrication of 1D organic heterostructures. The formation of two new types of 1D heterostructures is addressed: binary nanowires consisted either by two metal porphyrins or two metal htalocyanines and the open core@shell organic nanowires. The latter heterostructured nanowires consist in an inner wire of porphyrin or perylene partially wrapped by a phthalocyanine nanobelt (c.f. Figure 2) [1, 2]. On other hand, we will also demonstrate a new route for the ohmic connection of organic nanowires based on this new methodology [3].

References:

[1] Borras, A.; Aguirre, M.; Lopez-Cartes, C.; Groening, O.; Groening, P. Chem. Mater **24** (2008) 7371.
[2] Borras, A.; Groening, O.; Aguirre, M.; Gramm, F.; Groening, P. Langmuir (Under revision).
[3] Borras, A.; Groening, O.; Koeble, J.; Groening, P. Adv. Mater. DOI: 10.1002/adma.200901724 (2009).

Figures:

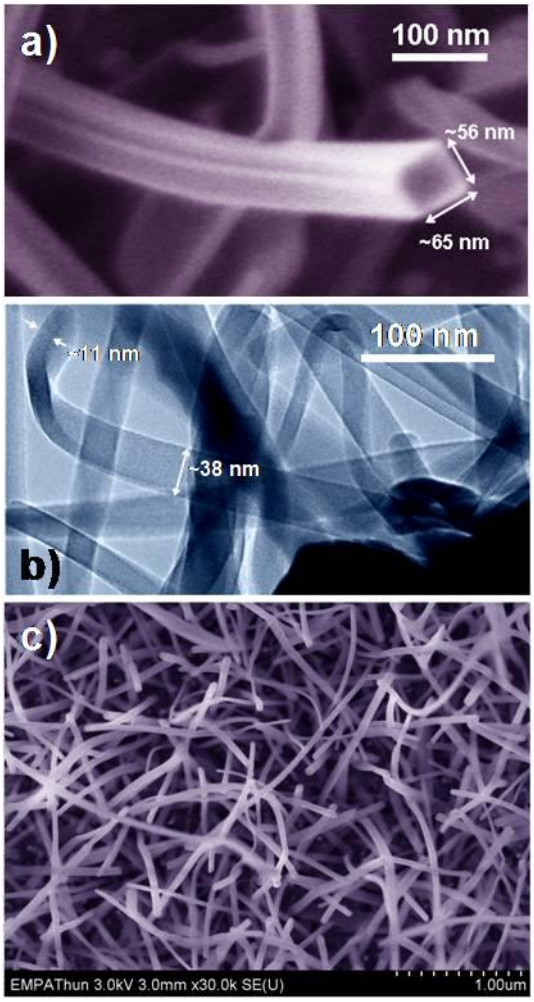

Figure 1. a) and b) TEM micrographs of a porphyrin squared nanowire and phthalocyanine nanobelt correspondently. c) Planar view SEM image of a high density of porphyrin nanowires grown on silver nanoparticles.

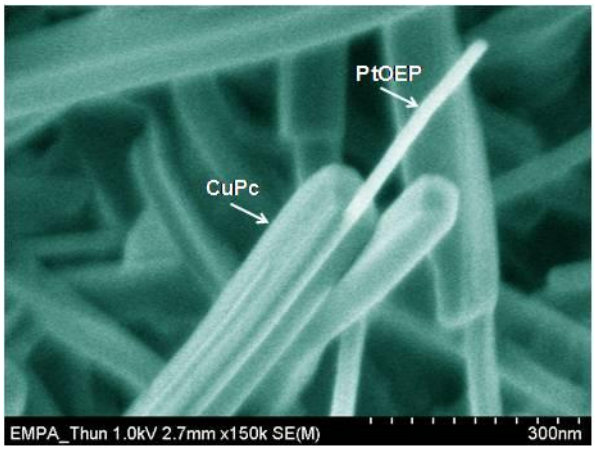

Figure 2. SEM image of a open core@shell nanostructure formed by an inner PtOEP nanowire partially wrapped by a CuPc nanobelt.