Forming Aligned Micellar Nanowires by De-wetting on Micro-pillars

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Macroscopic nanowire fabrication with well-ordered arrangement is of great interest in the physical, chemical, and biological fields due to their importance in both fundamental studies and technological applications in functional devices [1-2]. Organic nanowires have desirable properties for producing high-performance nano-devices, because of their low-cost, facile and large-scale synthesis, flexibility, simple processability and tunability by molecular design, in contrast with other. However, they display a disordered alignment with random positions during/after processing on large-scale. Their disorder alignment strongly hinders their application in the future functional devices, where often cross-linking and overlapping of nanowire takes place. Therefore, the ability to align the assembly of organic nanowires into desired architectures without damaging them is a prerequisite for integrating them into functional devices.

Here, we report a low-cost, novel and simple method to form nanowires by aligning ultra long worm-like micelles (see Figure 1) [3]. During the dewetting process the receding waterline slides on the micro-pillars and in so doing orients the worm-like micelles. The alignment speed and directionality is controlled by dragging the micelles solution along the array with a paper tissue that serves as an external capillary force source. In addition, the micelles are successfully decorated with hydrophobic molecules that incorporate into the micelle core or with the hydrophilic nanoparticles such as quantum dots entrapped in the corona. The presented block-copolymer patterning process based on surface dewetting has several advantages over conventional wire formation methods. The PDMS fabrication is a simple and affordable technique for which neither clean-room facility nor specialized training are required. In addition, the structure of the wires can easily be modified either chemically or by simple physical interactions creating new opportunities for specific chemical/biosensing applications.

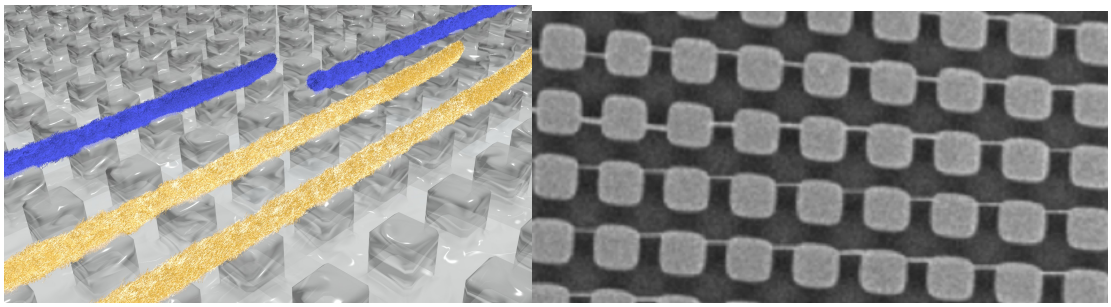


Figure 1: (Left) Schematic picture of suspended micellar nanowires on micro-patterned surfaces; (Right) Scanning Electron Microscopy (SEM) image of de-wetted PS-PEO nanowires on micro-patterned PDMS stamp.

References:

[1] **The art of aligning one-dimensional (1D) nanostructures**, Su, B.; Wu, Y. C.; Jiang, L., *Chem. Soc. Rev.* **2012,** *41*, 7832-7856.

[2] **The large area of laterally ordered nanochannel arrays from DNA combing and imprinting**, Jingjiao Guan, Pouyan E. Boukany, O. Hemminger, L. J. Lee,*Adv. Mat.* **2010**, 22, 3997-4001. DOI: 10.1002/adma.201000136.

[3] **Generating Aligned Micellar Nanowire Arrays by Dewetting of Micro-patterned Surfaces**, P.J. Glazer, L. Bergen, L. Jennings, A. J. Houtepen, E. Mendes and Boukany, P.E.*, *Small*, **2014**, 9, 1657. DOI:. DOI: 10.1002/smll.201303414.