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# Size Selective Rule of Nanowire Alignment by Solution based Coating Method

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One-dimensional nanostructures have potential as building blocks for nanoelectronics, nanophotonics and nanosensors. Precise placement of nanowires on desired substrate surface is essential for accelerating those application fields. Recently, several methods have been examined for nanowire alignment, and a solution-based self-assembly method has shown great potential for low-coat and large-scale processing. In this method, the nanowires dispersed in solution are selectively deposited onto chemically modified substrate surface to minimize the surface free energy. Since the surface area and the nanowire size may be of crucial importance for accurate nanowire alignment, understanding the effect of patterned surface area and nanowire size is necessary to realize high probability nanowire alignment. However, the fundamental knowledge as to such size effect for nanowire alignment is still scarce.

Here, we demonstrate a size selective rule for solution based nanowire alignment method. In this work, uniform Si nanowire arrays were fabricated by metal-assisted chemical etching of Si. The fabricated nanowires were dispersed into 1,4-dichlorobutane (oil). A series of hydrophilic-hydrophobic patterns ranged from nanoscale to microscale were prepared by electron beam lithography. Since the surface of Si nanowires was modified to be energetically favorable at water/oil interface, the nanowires were selectively deposited onto hydrophilic surface area during coating process. Systematic investigation with varying the patterned surface area and the nanowire size clarified the size selective rule for nanowire alignment. High deposition probability was successfully obtained when the nanowire surface area in water and oil can be almost equal. In addition, we demonstrate the size selective nanowire deposition using the different sized patterned area and nanowire size. These findings provide the fundamental design rule for diverse solution based nanowire alignment methods and extend the range of nanowire based device applications.