

Fabrication of Nanowires using Block-Copolymer Nano-Porous Templates with High Aspect Ratio

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In this study, we used polystyrene-block-poly(methyl methacrylate) copolymers (PS-b-PMMA) with PMMA cylindrical nanodomains to make nano-porous structures oriented perpendicularly to the substrate. PS-b-PMMA was spin-coated onto a neutral brush modified by PS-random-PMMA layer attached to the ITO glass. It is found that even if the thickness of the thin film increased up to ~300 nm, PMMA cylindrical microdomains were perpendicularly oriented to the substrates. Nanoporous templates were made after UV irradiation followed by rinsed by acetic acid. The hole diameter of pores was controlled by the amount of added PMMA homopolymer.

These nanoporous templates are also employed to produce photovoltaic devices with high conversion efficiency. For this purpose, hexagonally-packed nanowires of polypyrrole(PPy), poly(3-hexylthiophene)(P3HT), poly(ethylenedioxythiophene), which is commonly used as a P-type material, were prepared by electro-polymerization of monomer inside nanoholes. After removing PS matrix, N-type materials can be spin-coated. This geometry gives large contact area of P-N heterojunction, which allows a high efficiency of the current conversion from the light.