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Electrochemical Fabrication of Hexagonally Ordered Nanorod Arrays by Using Block Copolymer Template

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Block copolymers that consist of two or more polymer chains attached via a covalent bond are known to self-assemble into microphases with a variety of ordered morphologies, i.e. spherical, cylindrical, and lamellar structures. Microphase-separated block copolymer films have received significant attention for their potential in nanotechnology applications, i.e., block copolymer lithography and templating processes. The films can spontaneously form ordered microdomains, tens of nanometers in size, with surface densities up to 10^{12} in.$^{-2}$, and the microdomains possess inherent chemical and physical contrasts with the surrounding domains. A series of liquid crystalline block copolymer, PEO-*b*-PMA(Az), forms highly ordered PEO cylinder array with perpendicular alignment after thermal annealing. The cylinder diameter and its periodicity have been found as widely size-tunable with narrow distribution. The PEO cylinder in the film coated on an electrode can be expected to work as electrochemical nano-channel because the PEO forming cylinder is in undercooled state at room temperature. Herein, I demonstrate electropolymerization for conducting polymers and electroplating for gold (Au) through PEO cylinders just in microphase-separated PEO-*b*-PMA(Az) template. Hexagonally ordered nanorod arrays of conducting polymers and Au with diameter of ~10 nm, periodicity of ~25 nm, and density of ~10^{12} in.$^{-2}$ are successfully fabricated over large area.