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Title(English)	Study on Multiple Template Processes based on Microphase-separated Nanostructures of Block Copolymer Films
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Abstract

Microphase-separated block copolymer films have drawn much attention as one of the promising nano-sized template materials beyond the advanced top-down lithography. Novel concept of *multiple template processes* utilizing silica nanorod arrays as reliable templates toward functional nanomaterials is demonstrated in this study.

Firstly, chemical epitaxy method is applied to liquid crystalline (LC) poly(ethylene)-*block*-poly(methacrylate) with azobenzene mesogenes in their side chains (PEO-*b*-PMA(Az)) so as to axially and laterally control the PEO cylindrical microdomains with its (10) lattice spacing of 17.5 nm and areal density of 2 Tera-cylinders/inch². Then the direction-defined PEO cylindrical microdomains on the chemically patterned substrate are transferred into the gold nanodot arrays with same conformation as the direction-defined PEO cylindrical microdomains. Second, the silica nanorod templates are achieved by the use of the LC block copolymer films (as the 1st template), and combining sol-gel and reactive ion etching processes in order to develop perpendicularly oriented templates. The resulting silica nanorod array templates, which have diameter of 25 nm and periodicity of 50 nm, are used as the 2nd template for fabrication of versatile gold nanostructures, e.g. nanoholes, nanocups, toward plasmonic metamaterial application. Third, three-dimensional gold nanostructures are developed from the silica nanorod templates by sputtering of gold, and then its optical property is investigated by employing UV-vis spectroscopy. The transmittance and reflectance spectra of the three-dimensional gold nanostructures show completely different optical response from that of gold film as a reference material, which reveals the three-dimensional gold nanostructures would work as 10 nm-sized plasmonic metamaterial with response to visible light.

The present *multiple template processes* with the silica nanorod templates as the 2nd template fabricated by the LC block copolymer films (the 1st template) would open wide variety of applications in order to develop nano-sized materials across versatile research fields.