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Nanopatterning of Self-assembled Transition Metal Nanostructures on Oxide Support for Nanocatalysts

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Nanostructures, with a diversity of shapes, built on substrates have been developed within many research areas. Lithography is one powerful, but complex, technique to make structures at the nanometer scale, such as platinum nanowires for studying CO catalytic reactions [1], or aluminum nanodisks for studying the plasmon effect [2]. In this work, we approach a facile method to construct nanostructures using noble metals on a titania thin film by using self-assembled structures as a pattern. Here, a large-scale silica monolayer is transferred to the titania thin film substrates using a Langmuir-Blodgett trough, followed by the deposition of a thin transition metal layer. Owing to the hexagonal close-packed structure of the silica monolayer, we would obtain a metal nanostructure that includes separated metallic triangles (islands) after removing the patterning silica beads. This nanostructure can be employed to investigate the role of metal-oxide interfaces in CO catalytic reactions by changing the patterning silica particles with different sizes or by replacing the oxide support. The morphology and chemical composition of the structure can be characterized by scanning electron microscopy, atomic force microscopy and X-ray photoelectron spectroscopy. In addition, we modify these islands to a connected island structure by reducing the silica size of the patterning monolayer, which is utilized to generating hot electron flow based on the localized surface plasmon resonance effect of the metal nanostructures.

References

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