Nanopatterning of Polymer Replication Tools

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Nanopatterning of Polymer Replication Tools

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Motivation
The nanostructured surfaces, inspired by those seen in nature (Fig. 1), provide a broad range of advanced functionalities, such as stunning structural colors, antireflective, self-cleaning, superhydrophobic, superhydrophilic or antifogging effects. These effects are facilitated by the specific arrangement of micro- and nanostructures on the surface. Artificial nanostructured surfaces are usually limited to a flat, planar substrates. Injection molding, a widely used fabrication technique, is capable of replicating extremely small structures, but also of producing parts with complex, non-planar shapes, at very affordable cost. In order to use injection molding for making products with nanostructured surfaces, we need to fabricate molds facing the same problem.

Results
The device needed to deliver this extremely high hydrostatic pressure was specially developed and is shown on Figure 4. It uses a PDMS disk in the cavity as a pressure transfer medium. Figure 5 shows prepared nickel masters. If the thickness is high, 300-350 μm, one can use the foils directly as a mold insert, if the thickness is low, say 25-100 μm, foils are spray-coating method on flat and non-planar curved mold inserts. The cured HSQ films are durable and tough, which makes them good candidates for molds, but the imprinting of such high viscosity films as the HSQ dictates the use of extreme pressures, up to 800 bar, and the use of nanopatterned nickel masters.

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References