Supporting Information

Kim et al. 10.1073/pnas.1213331109

SI Materials and Methods

Heat-Induced Shear Thinning for Improving the Polydimethylsiloxane Replication Fidelity. High patternability was achieved by heat-induced shear thinning of polydimethylsiloxane (PDMS) prepolymer. PDMS has low patternability for nanotemplates with highly dense nanostructures of our bioinspired nanostructure. This patternability depends on both the viscosity and the wettability of PDMS prepolymer (1). In this work, the PDMS prepolymer was spin-coated on the nanotemplate and then heated at relatively high temperature of 150 °C to reduce the viscosity. Thin fluorocarbon film was deposited on the nanostructures to facilitate the relief of PDMS replica. The fluorocarbon film does not affect the wettability of PDMS prepolymer (See the similar contact angles of PDMS prepolymer on both glass and fluorocarbon surfaces as shown in Fig. S1). As a result, the successful patternability of PDMS was achieved by reducing the viscosity with heating under constant wettability.

Light Transmission of Planar Nanostructured Surfaces with Different Heights. See Fig. S3 for transmittance and transmission enhancement of a planar surface.

Demonstration of the Biologically Inspired LED Lens. There are five different LED lenses on the LED chip. For comparison, a smooth surface LED lens is placed on the left end. The other lenses have nanostructure on the curvature with different heights of 80 nm to 140 nm. Movie S1 demonstrates the comparison of light reflection from the lens surfaces. The biologically inspired LED lens with 120 nm in height clearly demonstrates the minimum reflection compared with the smooth surface LED lens, or other LED lenses with different heights of nanostructures.

1. Kang H, Lee J, Park J, Lee HH (2006) An improved method of preparing composite poly (dimethylsiloxane) moulds. *Nanotechnology* 17(1):197–200.

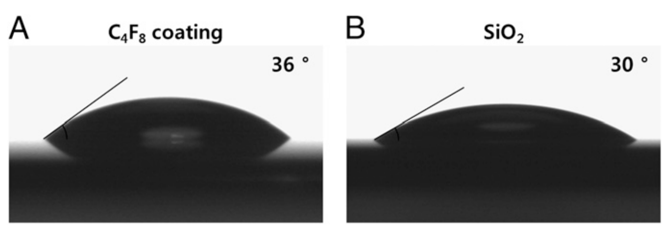


Fig. S1. Contact angles of PDMS prepolymer on (*A*) fluorocarbon and (*B*) glass surfaces.

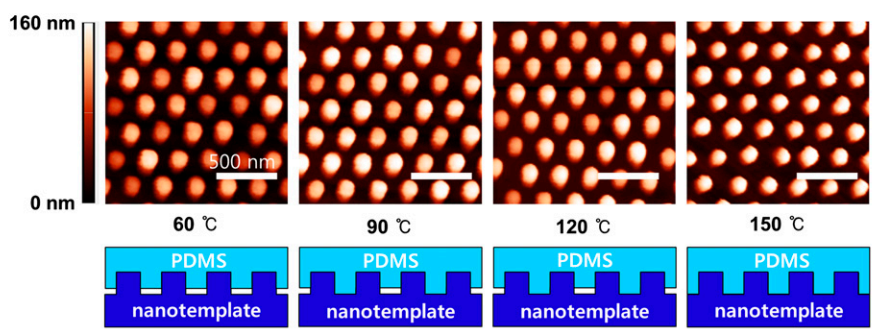


Fig. S2. Difference of replication resolution depends on the curing temperatures. Atomic force microscope (AFM) images of nanostructures replicating the PDMS nanostructures (*Upper*). Scheme of the replicated pattern depth with the different curing temperatures (*Lower*). The replication fidelity was characterized by changing the curing temperature. In this experiment, PDMS prepolymer was spin-coated on the nanotemplate with a 140-nm pattern height and cured at four different temperatures of 60, 90, 120, and 150 °C. Because of the low modulus of PDMS, all of the PDMS replicas with nanohole arrays were cast by a UV curable resin with high modulus for AFM measurement. The replication fidelity of PDMS to UV curable resin is very high, as previously reported. For this reason, the UV replica has nanopillar arrays, which are the negative counterparts of PDMS nanohole arrays. At 60 °C curing temperature, the nanostructures are not fully transferred from the SiO_2 nanotemplate to PDMS because of high viscosity. The height of nanostructures ranges from ∼100 nm to ∼120 nm. In addition, the nanotemplates are still not fully transferred to PDMS mold at 90 and 120 °C curing temperatures, even though the heights are increased from ∼120 nm to ∼140 nm. However, the fully transferred nanostructures are finally achieved at 150 °C. As a result, heat-induced shear thinning (lowering viscosity) of the PDMS prepolymer turns out to increase replication fidelity.

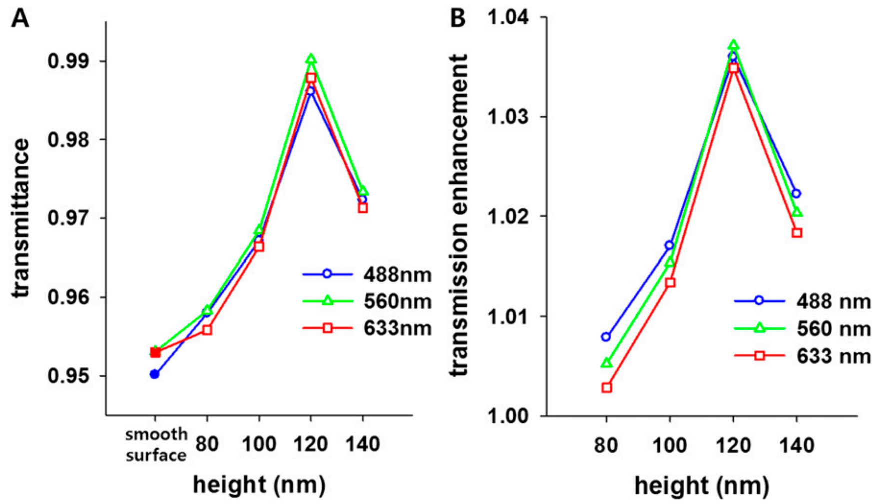
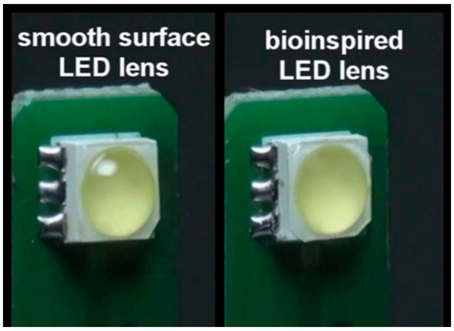


Fig. S3. Transmittance and transmission enhancement of a planar surface. Light transmission through the planar smooth and nanostructured surface was measured by an integrating sphere and spectrometer with an LED light source. (*A*) The planar nanostructured surface clearly shows high transmission over a full range of visible wavelengths, compared with that of a smooth surface. The calculated and measured results show that the transmittance is maximized at ∼120 nm in height. (*B*) The transmittance of planar surface increases over 3.6% on average in a visible range, which is comparable to the value on a lens surface.



Movie S1. Demonstration of the biologically inspired LED lens. There are five different LED lenses on an LED chip. For comparison, a smooth surface LED lens is placed on the left end. The other lenses have nanostructure on the curvature with different height 80 nm to 140 nm. This movie clip demonstrates the comparison of light reflection from the lens surfaces. The biologically inspired LED lens with 120 nm in height clearly demonstrates the minimum reflection compared with the smooth surface LED lens, or other LED lens with different height of nanostructures.

Movie S1