Supporting Information for publication

1. *Experimental section*

Nanolens fabrication method: The mixture of the precursors were prepared at the molar ratio of Crosslinker (1,6 hexanediol dimethacrylate): initiator (Benzophenone): coinitiator (Triethanolamine):monomer (Methyl methacrylate or lauryl methacrylate) at 5:5:5:85. All monomer and crosslinkers were passed through a basic alumina column prior to use. When a dye was used, the fluorescent dye was dissolved into the mixture of the precursors at the mass ratio of 1:100.

In the preparation of the first solution for solvent exchange, 1 mL of the mixture of precursors was added into 10 mL 50% ethanol/water solution. The clear precursor-saturated ethanol/water solution was used as the first solution. Water (Millipore, Watertown, MA, USA) was purged with argon to remove any dissolved oxygen and was then used to exchange 50% ethanol/water solution.

The substrate was silicon or glass hydrophobilized by a monolayer of OTS (Octadecyltrimethylchlorosilane). The hydrophobic surface was prepared using a method in literature. {Zhang, 2008 #16} The contact angles of water on the substrate were ~110^{o} (advancing) and ~95 ^{o} (receding), respectively.

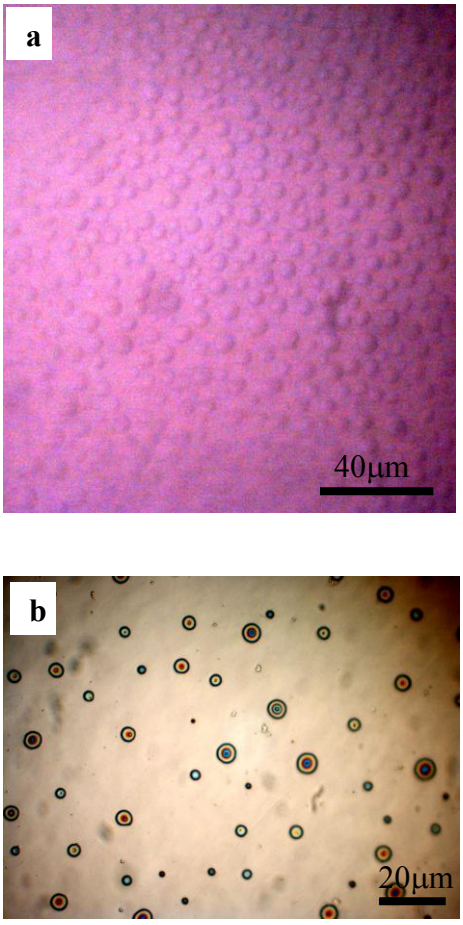
The procedure for the formation of nanodroplets at solid-water interface was used according to the early report.[3] Specifically, the solvent exchange was conducted inside a closed fluid cell with a glass

window. The first solution was injected into the cell, was then gently rinsed off with ~20 times volume of water. The liquid was cloudy at the initial exchange due to the emulsion formation, and became completely clear by the end of exchange. During the whole exchange process, the cell was wrapped inside a black paper to avoid the light. After the formation of nanodroplets by the solvent exchange, the cell was placed under the UV light for the polymerization. If the polymerization was conducted in an ethanol solution other than water, the nanodroplets were produced first in water, and then water was gently exchanged by the ethanol solution before the polymerization.

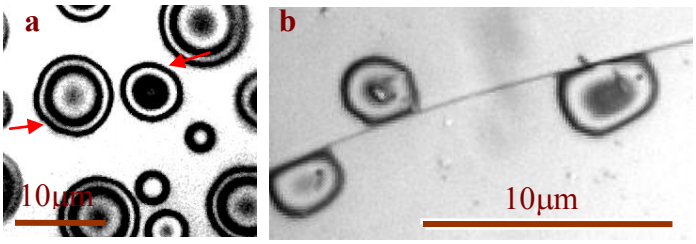
Characterization: Tapping mode AFM (Multinode IV, Bruker) was used to image the nanodroplets. After the solvent exchange in a closed AFM fluid cell, the surface was imaged in water.

MFP-3D Atomic Force Microscope (Asylum Research, Santa Barbara, CA) was used to obtain the images of nanolenses over a large area in air. Scanning electron microscopy (XL 30 Philips Head SEM) was used to obtain the side-view of nanolenses. Samples were coated with a gold layer using a Dynavac Mini Sputter Coater prior to imaging. Fluorescent microscope images were illuminated with an Hg arc lap and captured using an inverted Olympus IX71 microscope. A camera (Cool SNAP fx, Photometrics, Tucson, AZ) was mounted on the left-hand port of the microscope.

Supporting Figure S1. Optical images of nanolenses formed on different substrates. (a) On a transparent hydrophobic glass. No reflection patterns can be observed. (b) On a non-transparent HOPG substrate. The reflection patterns (reversed Newton rings) can be observed.

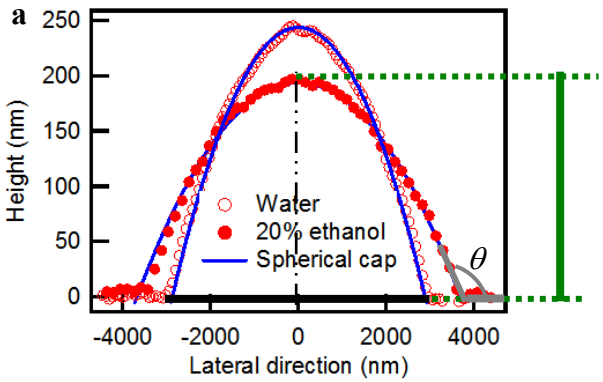


Supporting Figure S2. Optical Newton rings formed by nanolenses. (a) Non-circular Newton rings (pointed by red arrows) formed on substrate and the irregularity of the rings was caused by the heterogeneity on OTS-Si substrate. (b) Optical image of nanolenses on a HOPG substrate with a step. The shape of the lenses is distorted by the cleavage steps on HOPG. Through the formed optical patterns, nanolenses fabricated by this method might be used to observe the local heterogeneity on the solid surface.



Supporting Figure S3. Morphology of nanolenses fabricated in different media. (a) Cross sectional profiles of nanolenses fabricated in water and 20% ethanol solution. (b) The profile of nanolens in water was fitted with both parabolic and spherical cap. (c)(d) The plot of radius versus the lateral diameter (R) of nanolenses fabricated in water (b) and in 20% ethanol solution (c). (e) Corresponding to (c), the morphology of crosslinked PMMA nanolenses polymerized in water is further analyzed in (e).

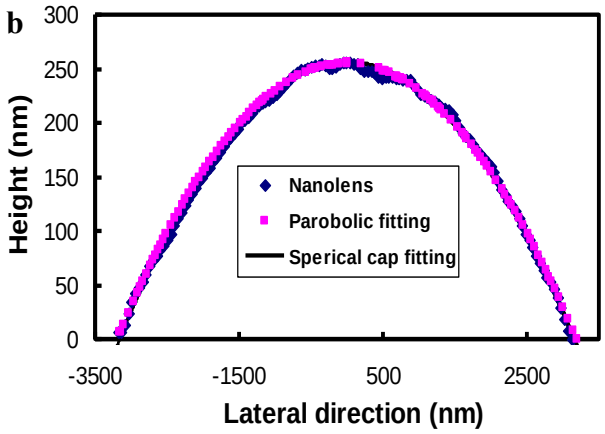
The profile of a nanolens can be fitted well with a spherical cap shown by the blue curve in (a) or with a parabolic shown by pink points in (b). The parabolic fits slightly better near the bottom of the lens and the spherical cap, slightly better on the upper region. We note that the length scale in x-axis is ~40 times larger than in y-axis. From the measured height and the lateral diameter, the contact angle (θ) defined through the water phase can be calculated based on the spherical cap. The cosine of contact angles of the nanolenses ranging from 155-168^{o} was plotted against the corresponding local lateral curvatures (1/R), based on the nanolenses images by tapping mode AFM. $\cos\theta$ is *not* well corrlected with $1/R$ (R^2=0.58), indicating that the shape of the nanolenses might be influenced by additional factors.

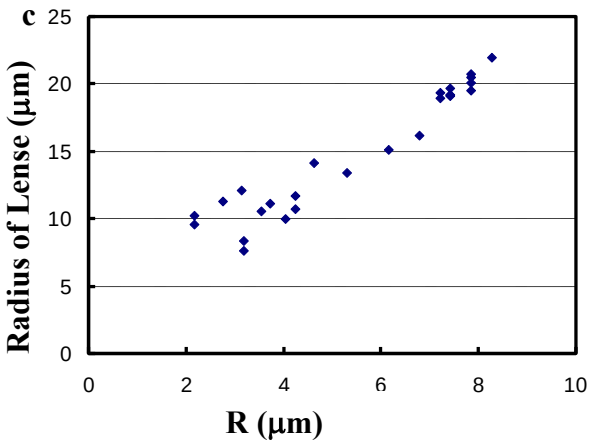


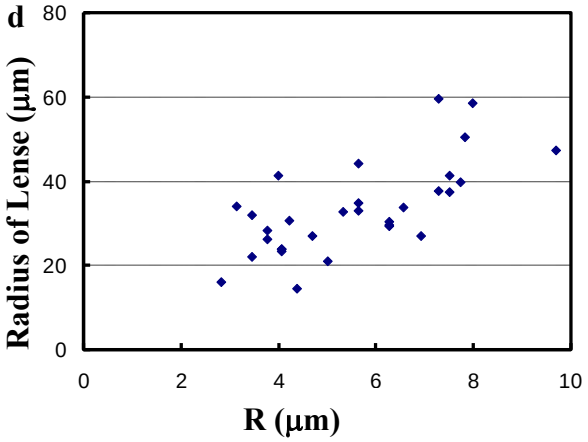
Height (*H*)

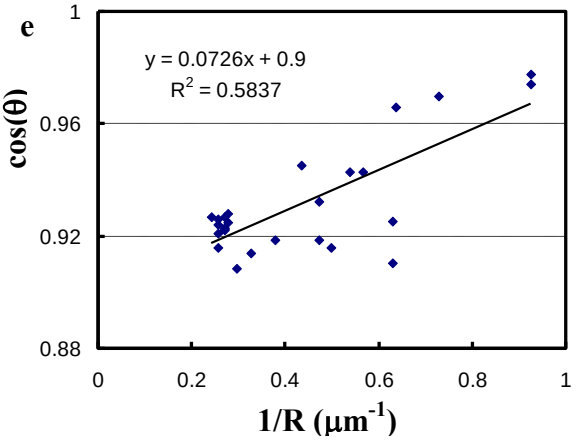
Lateral diameter(R)

Contact angle (θ)









Supporting Figure S4. Optical images of nanolenses after rinsing with organic solvents. (a) Nanolenses of cross-linker (1,6 hexanediol dimethacrylate). After the polymerization, the fluid cell was rinsed with toluene before the substrate was taken out. (b) Nanolense of crosslinked LMA. After the polymerization, the fluid cell was rinsed with ethanol before the substrate was taken out.