Supporting Information

Demonstration of temperature-plateau superheated liquid by photothermal conversion of plasmonic titanium nitride nanostructures

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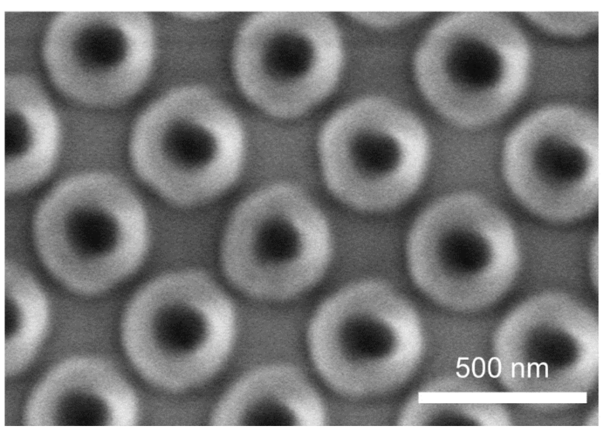

Figure S1. SEM image of the array on the glass substrate.

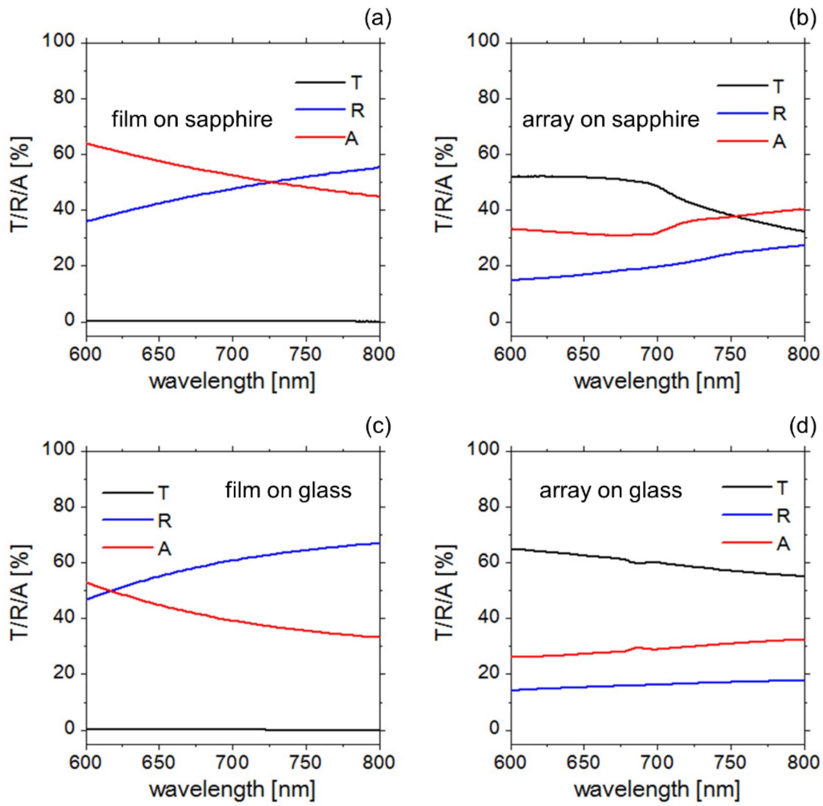

Figure S2. Transmittance (T), reflectance (R) and abosptance (A) of the four samples where the superstrates were air. (a) Film on the sapphire substrate, (b) array on the sapphire substrate, (c) film on the glass substrate and (d) array on the glass substrate.

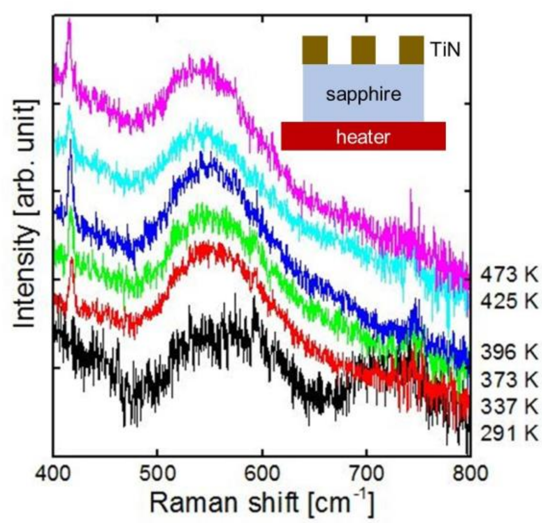

Figure S3. Stokes peaks of the array on the sapphire substrate recorded at various temperatures. The sample was heated by a sample heater and the temperature was monitor on the surface of the sample. The sharp peak at ~410 cm^{-1} was from the sapphire substrate. The excitation was a He-Ne laser at ~3 mW.

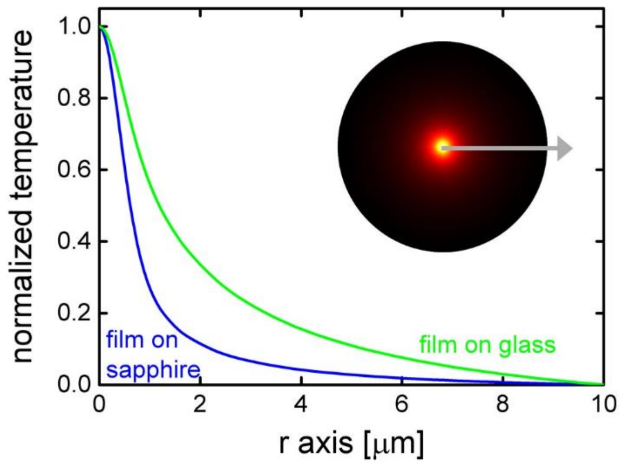

Figure S4. Simulated temperature profiles of the TiN films on the sapphire and glass substrates where the superstrates are air. The inset shows the normalized temperature map of the TiN film on the sapphire substrate. The size of the color map is 10 μm in radius.

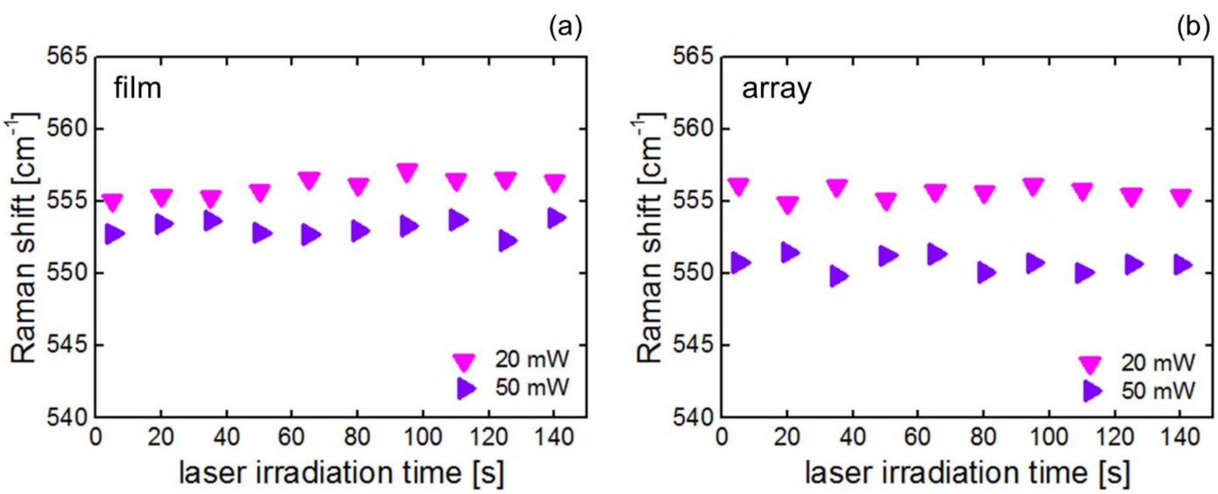

Figure S5. Time dependent Raman shift for (a) the TiN film on the sapphire substrate and (b) TiN array on the sapphire substrate where the superstrates are water.

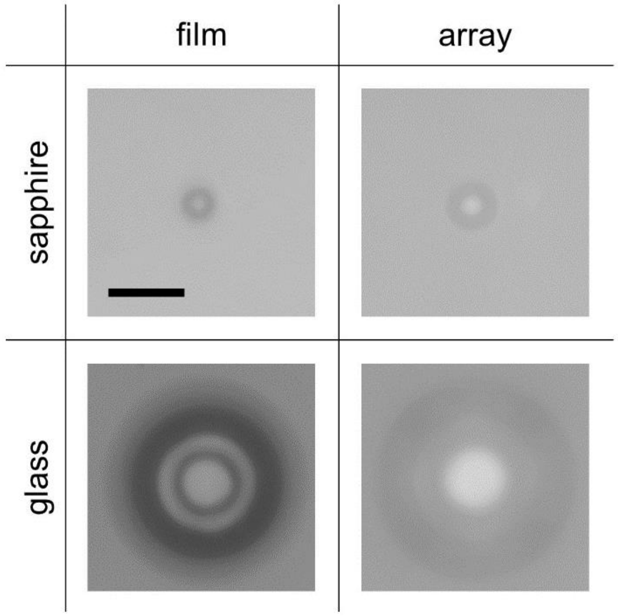

Figure S6. Optical images of the bubbles of the four different samples with water superstrates; TiN film on sapphire substrate, TiN array on sapphire substrate, TiN film on glass substrate, and TiN array on glass substrate. All the images were taken at the same magnification and the scale bar shows 20 μm.

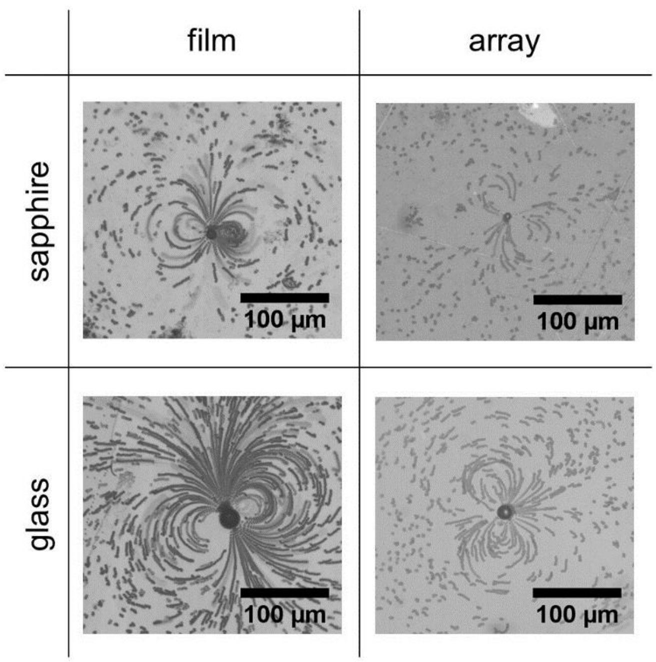

Figure S7. Visualized Marangoni flows of four different samples with water superstrates; TiN on sapphire substrate, TiN array on sapphire substrate, TiN film on glass substrate, and TiN array on glass substrate. To visualize Marangoni flows, polystyrene spheres were dispersed in water before the measurements.

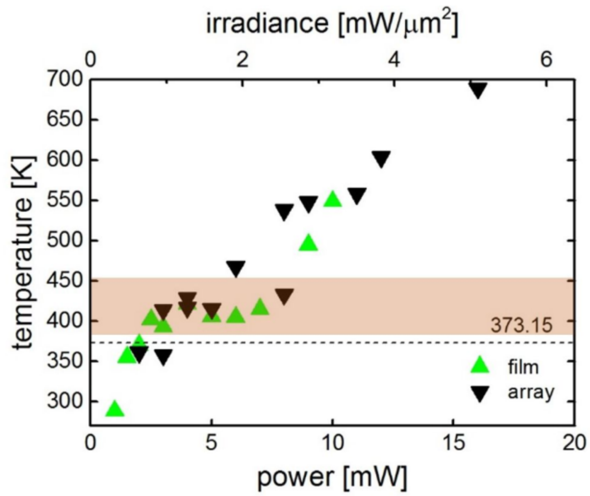

Figure S8. Experimentally recorded laser power dependent temperature of the samples with the glass substrates and water superstrates. The data are identical to Figure 4(d) in the main text but plotted with a different x-axis range. The top x-axis was calculated from the bottom x-axis using the beam area.

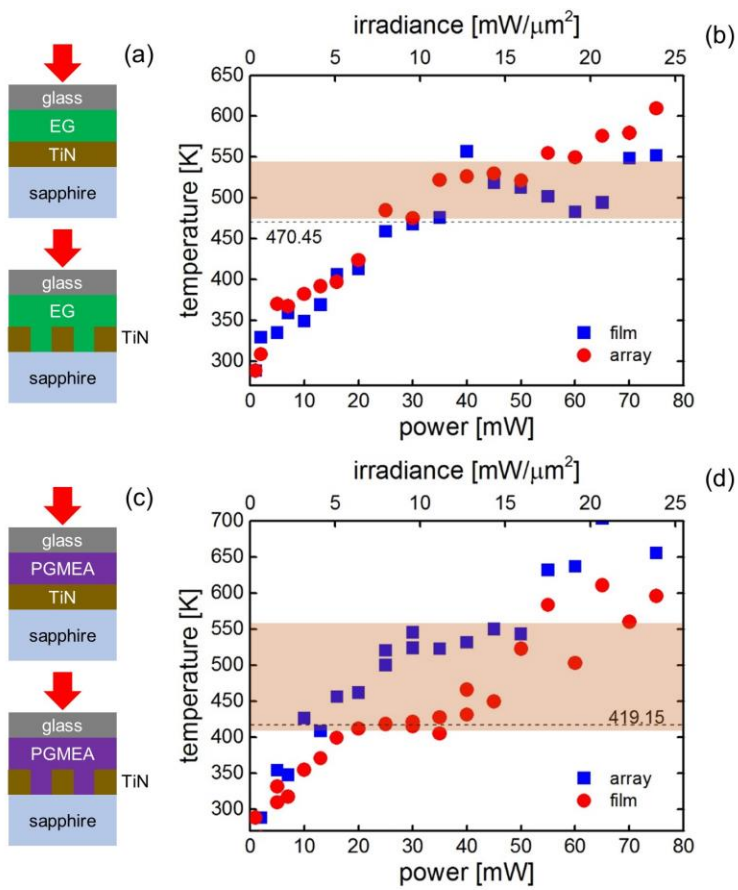

Figure S9. (a) Schematics of the samples with sapphire substrates where the superstrates are ethylene glycol (EG) layers. (b) Laser power dependent temperature increase of the samples with EG as superstrate. (c) Schematics of the samples with sapphire substrates where the superstrates are 2-Acetoxy-1-methoxypropane (PGMEA) layers. (d) Laser power dependent temperature increase of the samples with PGMEA as superstrate. The dotted horizontal lines indicate the boiling temperatures. The top x-axes in panel (b) and (d) were calculated from the bottom x-axes using the beam area.

Note 1. Heat transfer simulation

Heat transfer simulations were performed using a commercial finite element solver (COMSOL Multiphysics). The geometry and material properties were defined from the actual samples, except for the array samples. For the array samples, the array was modeled as an effective film that had the same height of the array.

Laser irradiation was modeled as an incoming heat flux multiplied by the absorptance of a sample at the top of the TiN nanostructure. The heat flux was set to have a Gaussian profile to imitate the laser beam profile. The radiative and convection heat losses from the top of the TiN nanostructure were included in the model. The the side and bottom boundary conditions were set to be constant temperature at the room temperature.