

High-aspect-ratio mushroom-like silica nanopillars immersed in air: epsilon-near-zero metamaterials mediated by a phonon-polaritonic anisotropy

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1. SEM images of SiO₂ dot arrays without O₂ plasma process.

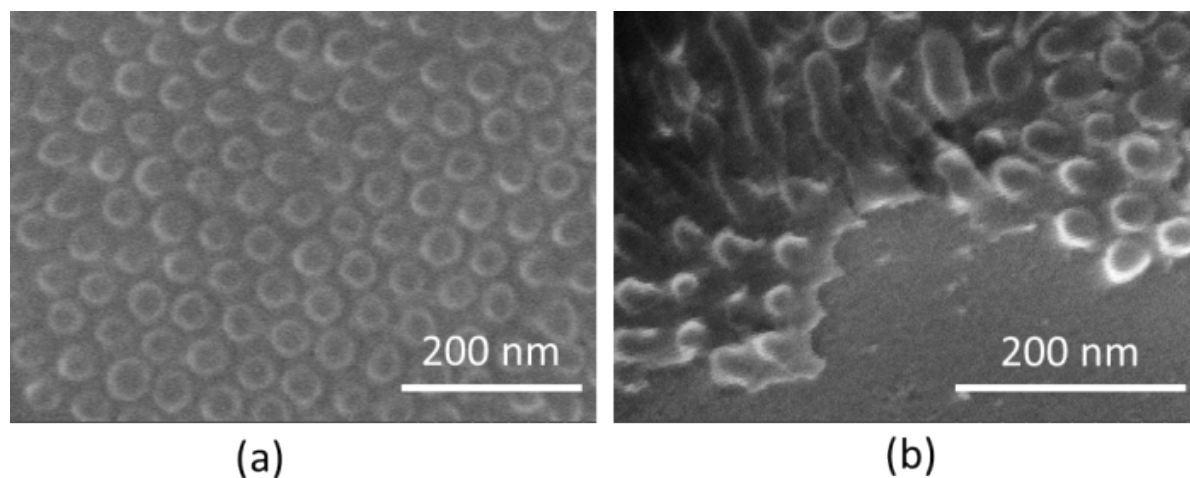


Figure S1 SEM images of SiO₂ dot arrays fabricated from the 5 wt % PS-*b*-PDMS solution without O₂ plasma process. After the continuous CF₄ and O₂ RIE, a film was calcined at 450 °C successively. Although, the hexagonal regularity is maintained in (a), only dot arrays are unveiled in (b).

2. X-ray photoelectron spectroscopy (XPS) depth profiling analysis on SiO₂ nanopillars.

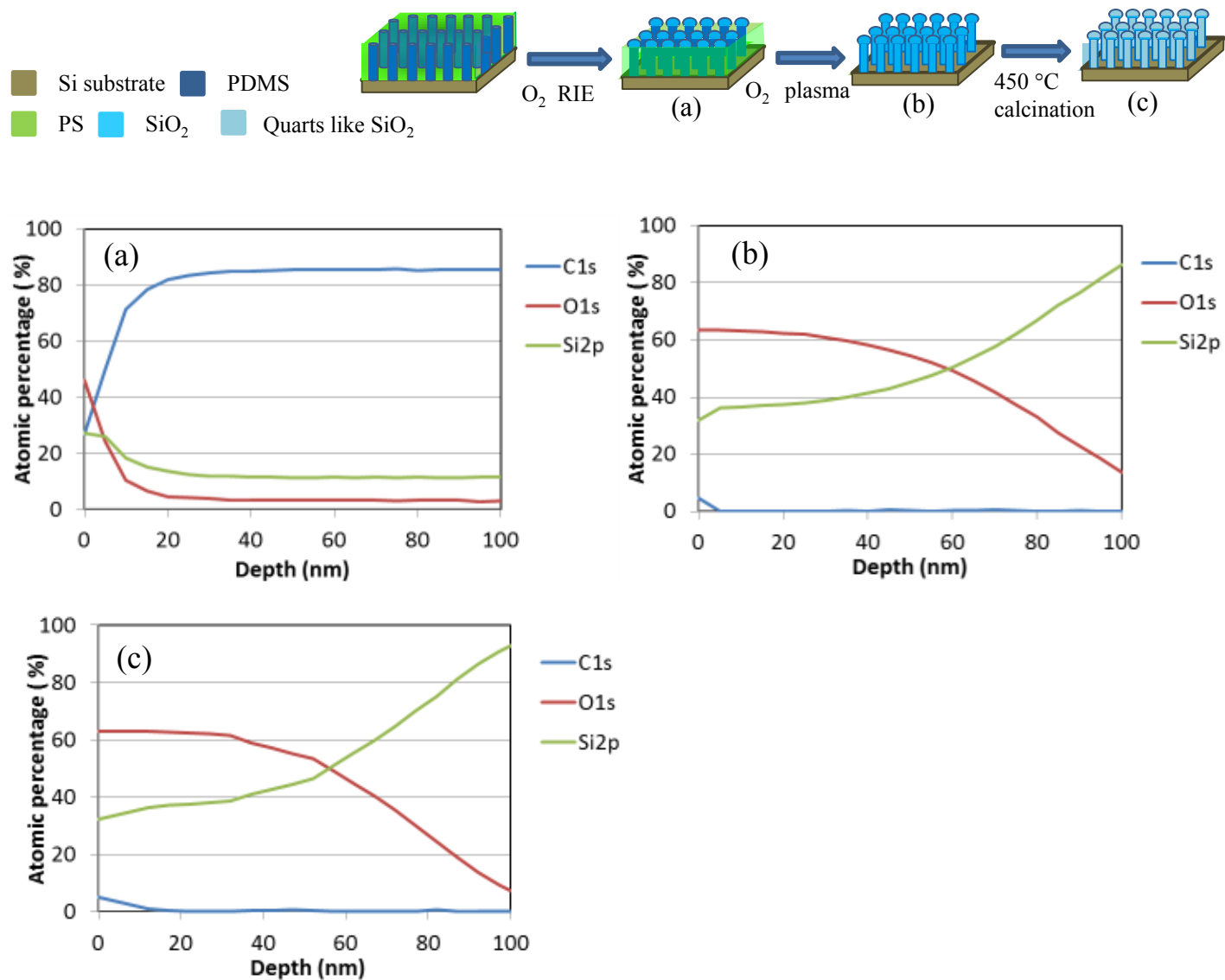


Figure S2 XPS depth profile analysis was carried out to assess the chemical states of nanopillars after (a) O₂ RIE (before O₂ plasma), (b) O₂ plasma for 240 s, and (c) O₂ plasma for 240 s, followed by calcination at 450 °C. Measurements were conducted with a Quantera SXM (ULVAC-PHI, Inc.) with monochromated Al K α radiation at a take-off angle of 45°. Relatively thick oxide layers are confirmed in (b) and (c) from O1s core level spectra.

3. Depolarization factors

The depolarization factor measures the degree of the film uniformity and the backside reflection. The depolarization factor is expressed as:

$$p = 1 - \sqrt{(S_1^2 + S_2^2 + S_3^2)/S_0}$$

where S_1 , S_2 and S_3 are the Stokes parameters. When the depolarization factor is 0, the light is totally polarized. When the depolarization factor is 1, the light is unpolarized. On the measurement, we have verified that the depolarization factor is close to 0.

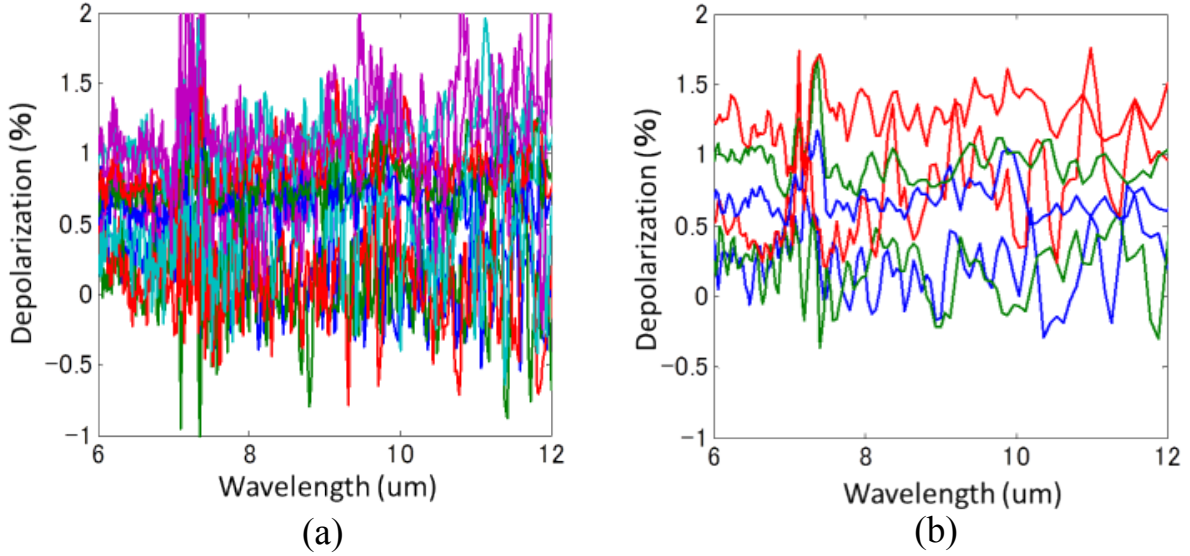


Figure S3 Depolarization factors measured in the optical ellipsometry on (a) nanopillars fabricated from the 5 wt% PS-*b*-PDMS solution and (b) the Si substrate. Data are obtained at angles of 55° (blue line), 60° (green line), 65° (red line), 70° (cyan line), and 75° (purple line), respectively.

4. Calculated Lorentz parameters

Table S1 Lorentz parameters to fit the ellipsometrically measured parameters Ψ and Δ .

ϵ_∞	A_1	ω_{01} (rad/sec)	Γ_1 (rad/sec)	A_2	ω_{02} (rad/sec)	Γ_2 (rad/sec)	f
1.884	0.0969	2.207×10^{14}	2.810×10^{13}	0.4044	2.015×10^{14}	9.669×10^{12}	0.292