Electronic Supplementary Information

Tailoring the Lateral Size of Two-Dimensional Silicon Nanomaterials to Produce Highly Stable and Efficient Deep-Blue Emissive Silicene-Like Quantum Dots

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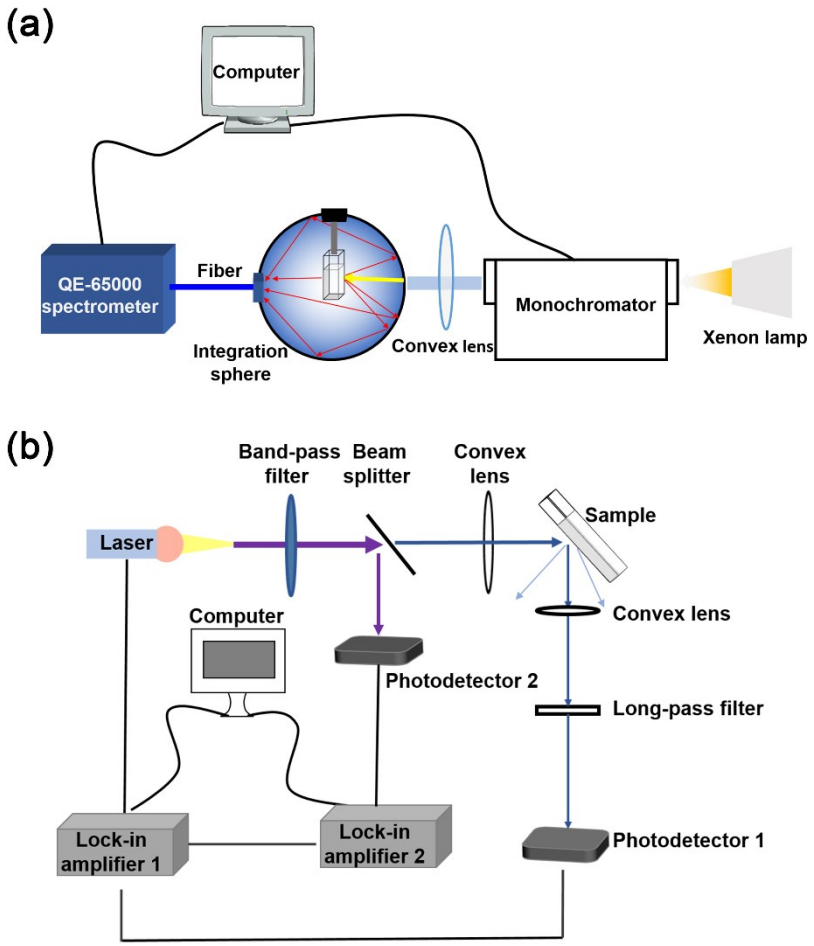

Fig. S1. Schematic diagram of PL QY measurement systems. a) The absolute PL QY measurement system. b) The excitation density-dependent PL QY measurement system.

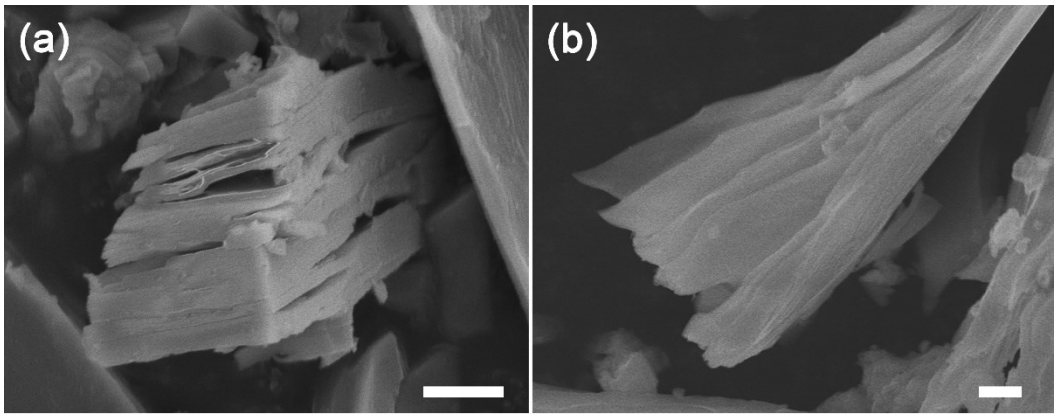

Fig. S2. SEM morphology of a) the compact layered structure of $CaSi_2$ and b) the loosely-stacked sheets of the exfoliated siloxene. Scale bar: 1 μm.

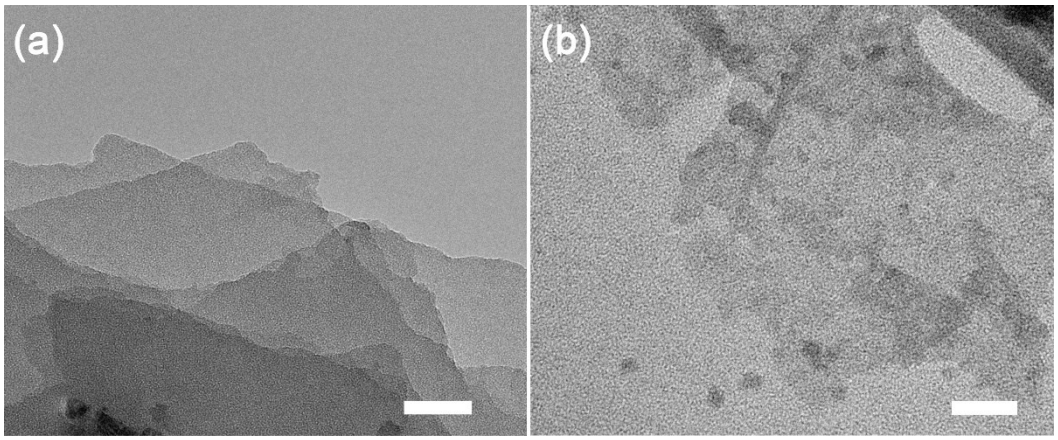

Fig. S3. TEM images of a) the siloxene and b) the HF etched samples, showing morphology conversion from the stacked sheets to the smaller and thinner flakes. Scale bar: 50 nm.

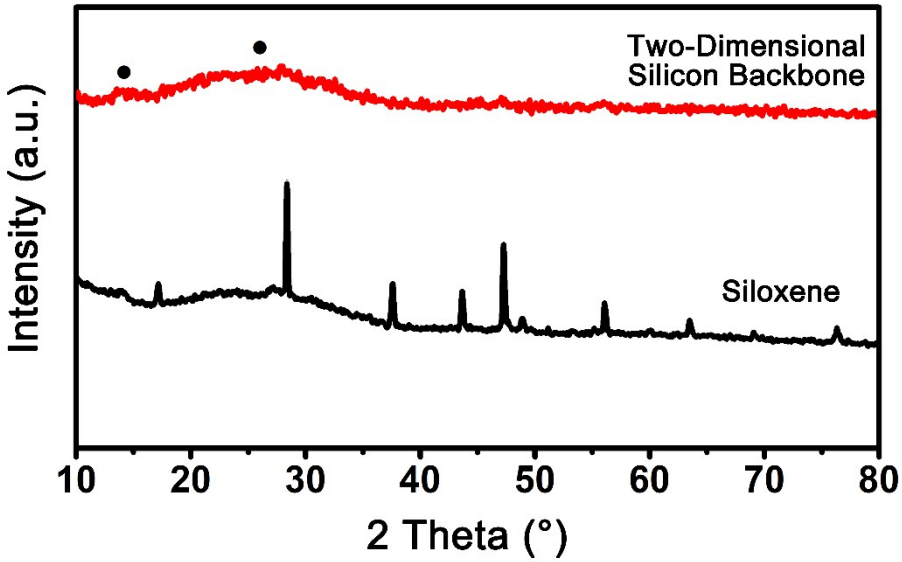

Fig. S4. XRD patterns of the as-prepared siloxene and the obtained two-dimensional silicon backbone afte HF etching.

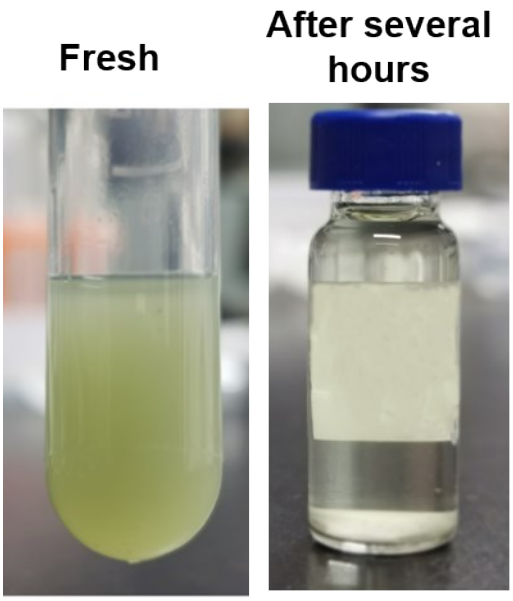

Fig. S5. Photographs of the colloidal solution of the obtained two-dimensional silicon backbone before ultrasonic, showing the precipitate at the bottom after storage for several hours.

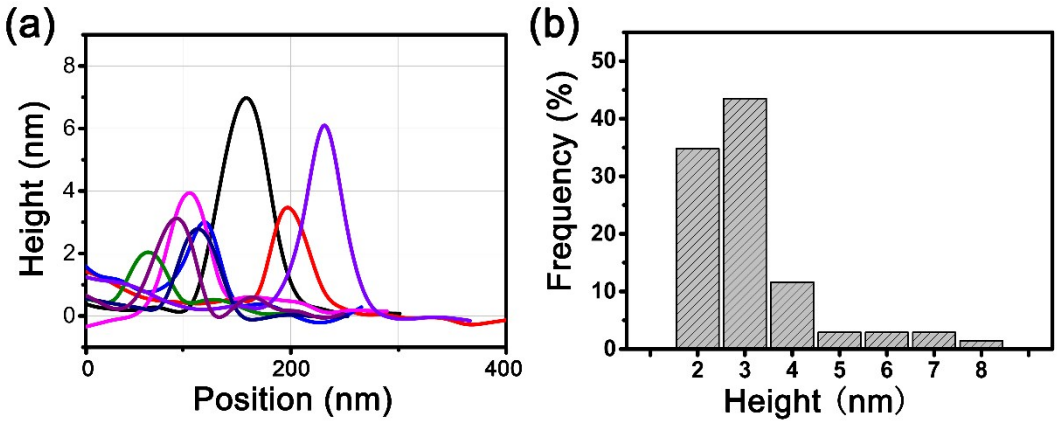

Fig. S6. a) Height profiles of several typical dots. b) Histogram of heights distribution of the silicene-like QDs.

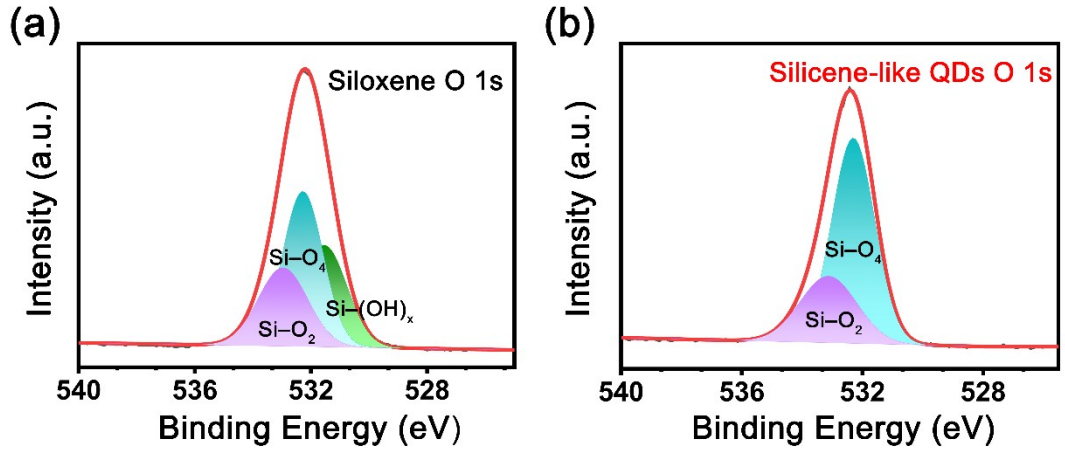

Fig. S7. High-resolution XPS O 1s core level spectra of a) the siloxene and b) the silicene-like QDs.

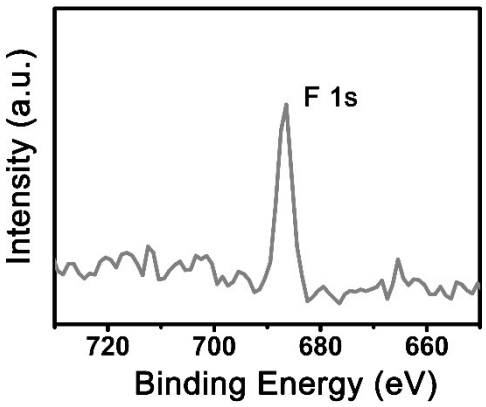

Fig. S8. XPS F 1s core level spectrum of the silicene-like QDs.

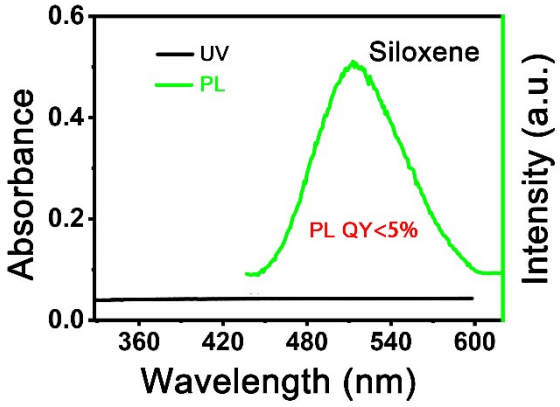

Fig. S9. UV–Vis absorption and PL spectrum of the exfoliated siloxene.

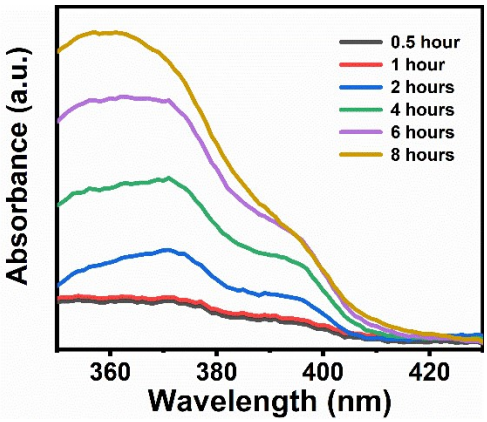

Fig. S10. The absorbance of silicene-like QDs under different ultrasonic time.

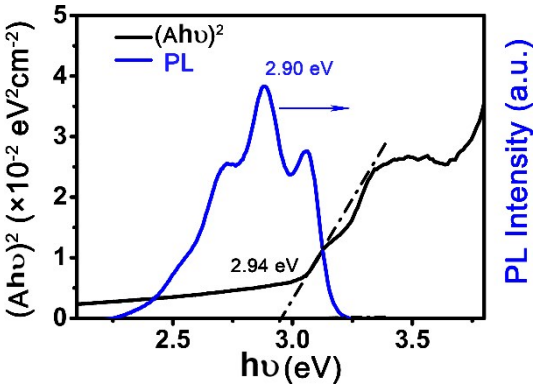

Fig. S11. Plots of $(Ahv)^2$ versus the photon energy calculated from the absorbance measurement (black) and PL spectra of the silicene-like QDs (blue).

Based on the UV–Vis absorption spectrum shown in Fig. 4a, the optical bandgap E_g is obtained according to the following equations:

$$\alpha hv = B(hv - E_g)^m \#(1)$$

Where α is the absorption coefficient values, B is a constant, hv is the photon energy and E_g represents the bandgap energy of the materials. m depends on the nature of the transition. [S1, S2]

According to Lambert Beer's law:

$$A = \alpha bc \#(2)$$

Where A is the absorbance, b is the thickness and c is the concentraction of solutions, bc is a constant. If $B_1 = \left(\frac{B}{bc}\right)^{1/m}$, thus,

$$(Ahv)^{\frac{1}{m}} = B_1(hv - E_g) \#(3)$$

For direct transitions, m is 1/2. Therefore the E_g of silicene-like QDs is calculated by extrapolating the linear portion of the plot $(Ahv)^2$ versus hv to A = 0. [S3, S4] Consequently, it shows a direct bandgap of 2.94 eV, which is close to the PL peak energy of 2.90 eV.

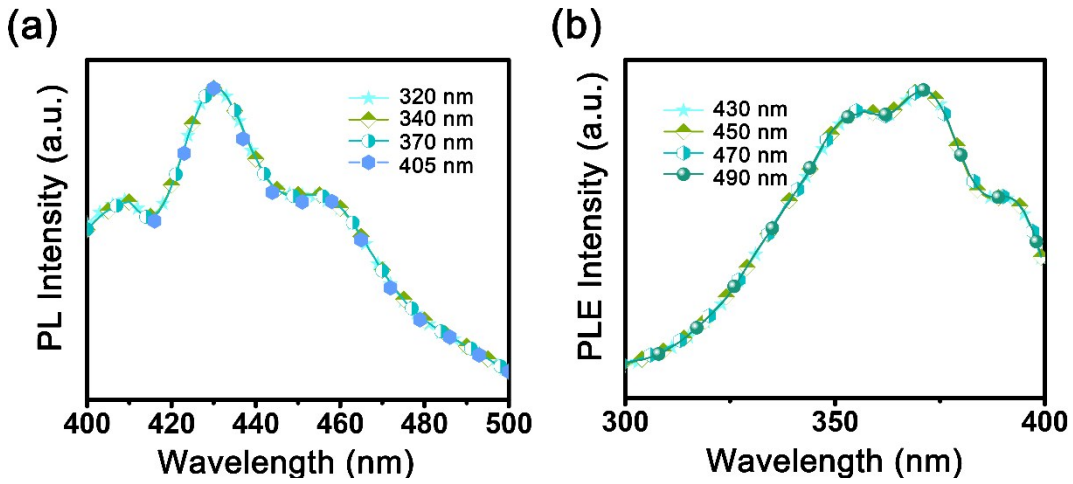

Fig. S12. a) PL spectra of the silicene-like QDs measured at an excitation wavelength ranging from 320 nm to 405 nm. b) PLE spectra of the silicene-like QDs collected a wavelength ranging from 430–490 nm.

Table S1. Calculated ratio of O/Si elements from XPS analysis of the siloxene and the silicene-like QDs.

Name	Element	Atomic (%)	O/Si
Siloxene	O 1s	48.45	1.43
	Si 2p	33.87	
Silicene-like QDs	O 1s	34.04	0.81
	Si 2p	41.97	

Reference

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S3 F. Bouaichi, H. Saidi, A. Attaf, M. Othmane, L. Nadia, M. Nouadji, M. Poulain and S. Benramache, Main Group Chem., 2015, 15, 57-66.

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