Supplementary Materials

Highly Efficient Energy Transfer from Silicon to Erbium in Erbium-Hyperdoped Silicon Quantum Dots

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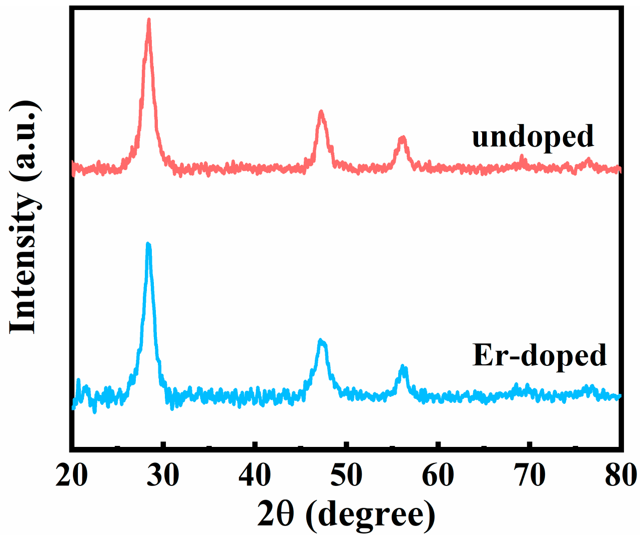

Figure S1. XRD patterns of Si QDs with pristine and Er hyperdoping.

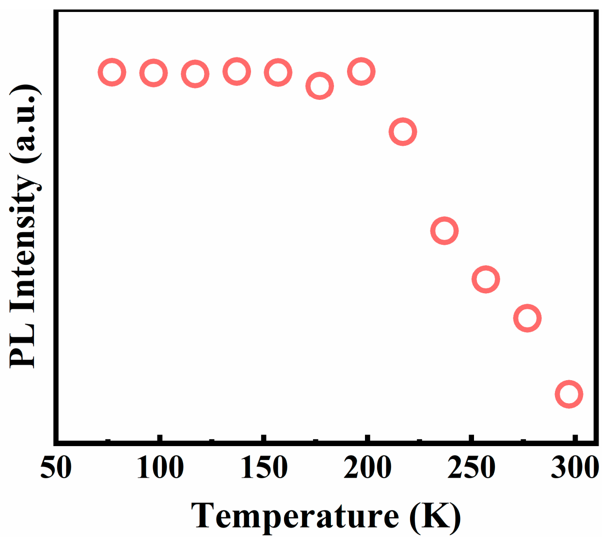

Figure S2. Temperature-dependent integrated emission intensity of undoped Si QDs.

Table S1. Atomic fraction of various charge states of Si

Sample	$N_{Si^{0+}}$	$N_{Si^{1+}}$	$N_{Si^{2+}}$	$N_{Si^{3+}}$	$N_{Si^{4+}}$	SiO_x	*d (nm)*
Undoped Si QDs	30.29	42.93	7.11	0	19.56	$SiO_{1.0}$	0.8
Er-hyperdoped Si QDs	41.98	43.21	7.38	7.43	0	$SiO_{0.7}$	0.6

Note S1. The fitting of PL decay curves and the determination of PL lifetime

Both of the PL decay curves can be well-fitted by a biexponential equation

$$I(t) = A_1 e^{-\frac{t}{\tau_1}} + A_2 e^{-\frac{t}{\tau_2}}, \quad \text{(S1)}$$

where $I(t)$ is the PL intensity at time t, A_1 and A_2 are fitting constants, and τ_1 and τ_2 are the fast and slow decay time, respectively. The effective average lifetime τ can be estimated by the following equation [9]

$$\tau = \frac{A_1 {\tau_1}^2 + A_2 {\tau_2}^2}{A_1 \tau_1 + A_2 \tau_2}, \quad \text{(S2)}$$

References

9. Wang, K.; He, Q.; Yang, D.; Pi, X. Erbium-Hyperdoped Silicon Quantum Dots: A Platform of Ratiometric Near-Infrared Fluorescence. *Adv. Opt. Mater.* **2022**, *10*, 2201831, doi:10.1002/adom.202201831.