SUPPLEMENTARY INFORMATION

Stabilizing Perovskite Quantum Dot Oxygen Sensors through Ultra-Long 2 mm Horizontally Aligned Nanopores in Anodic Alumina Oxide Templates

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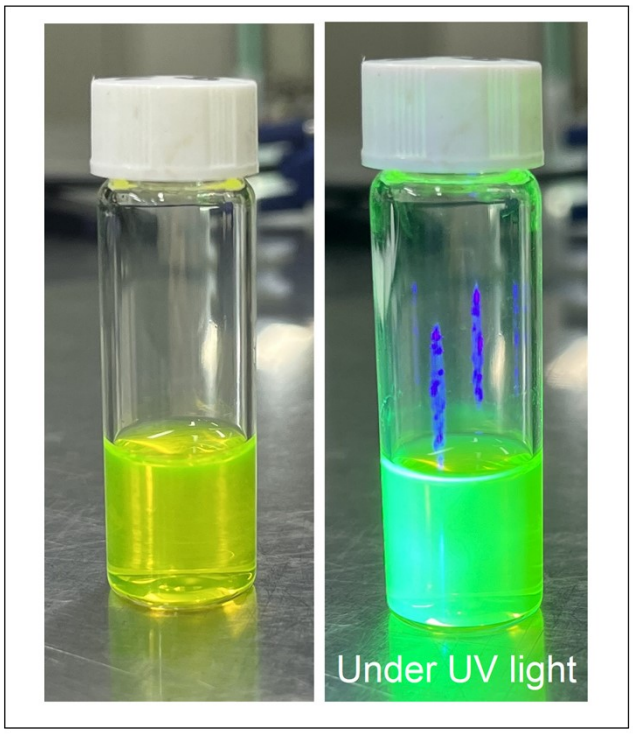

Fig. S1 $FAPbBr_3$ quantum dots dispersed in octane.

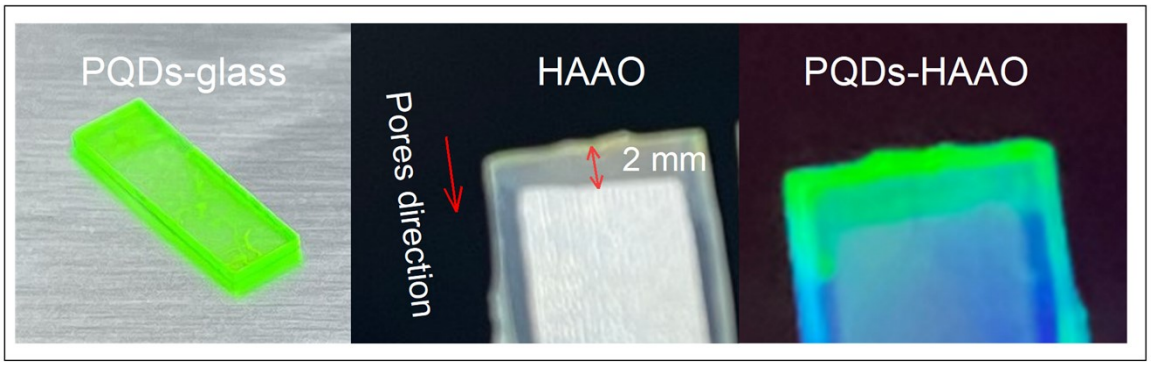

Fig. S2 Photographs of samples showing glass with deposited PQDs (PQDs-glass), HAAO alone, and HAAO with embedded PQDs (PQDs-HAAO). The PQDs used in this study are $FAPbBr_3$ quantum dots.

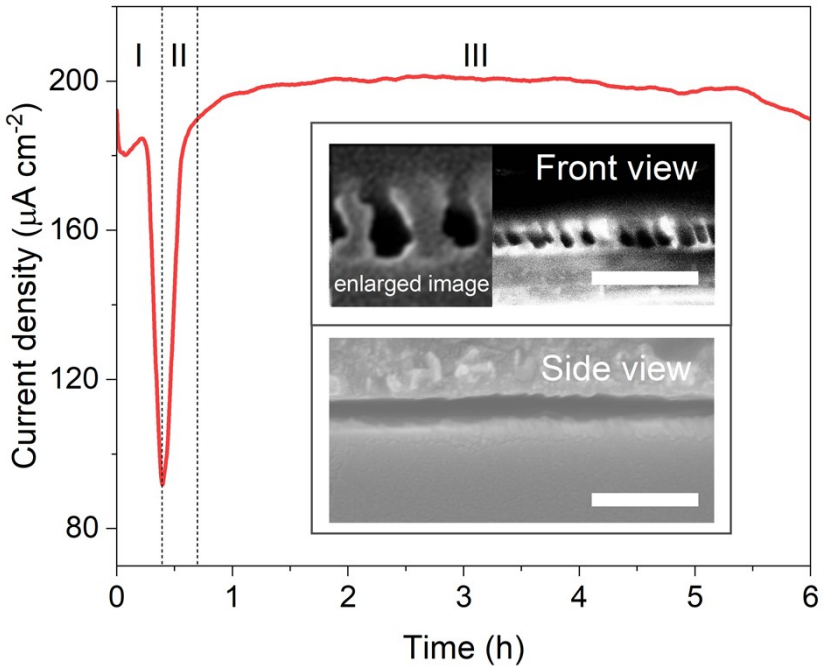

Fig. S3 Current density–time transient during hard anodization process in 0.3 M H_2SO_4. The inset shows SEM images of a typical HAAO film. The scale bars in the SEM images are 200 nm.

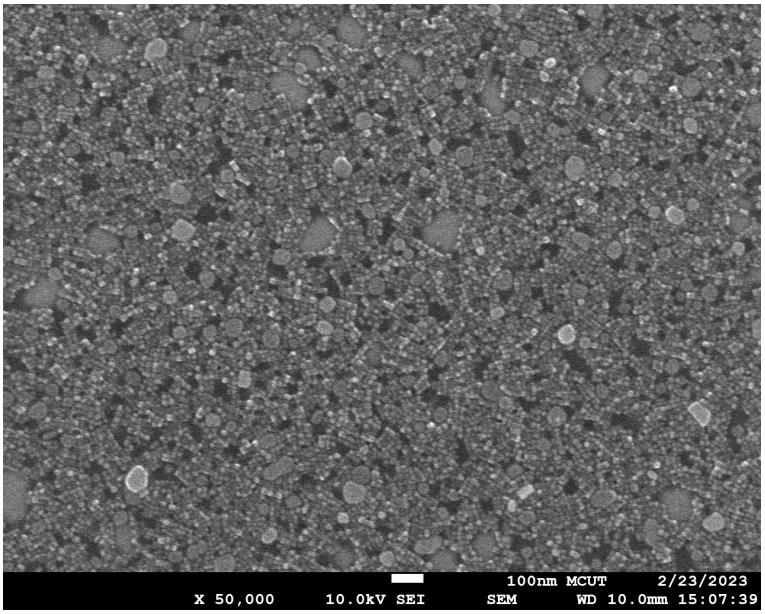

Fig. S4 SEM image of $FAPbBr_3$ quantum dots.

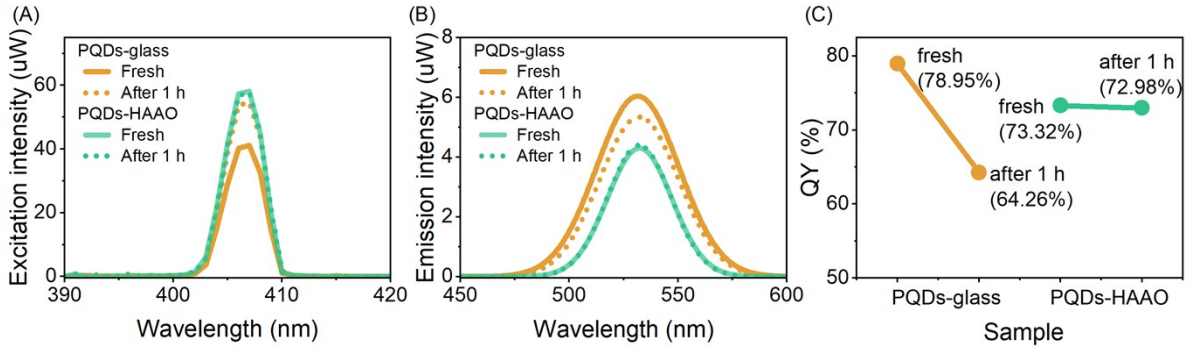

Fig. S5 The QY characteristics of PQDs with different substrates. (A) Excitation and (B) emission spectra. (C) The changes of QY after stored in oxygen-enriched atmosphere (~20% oxygen) for 1 hour.

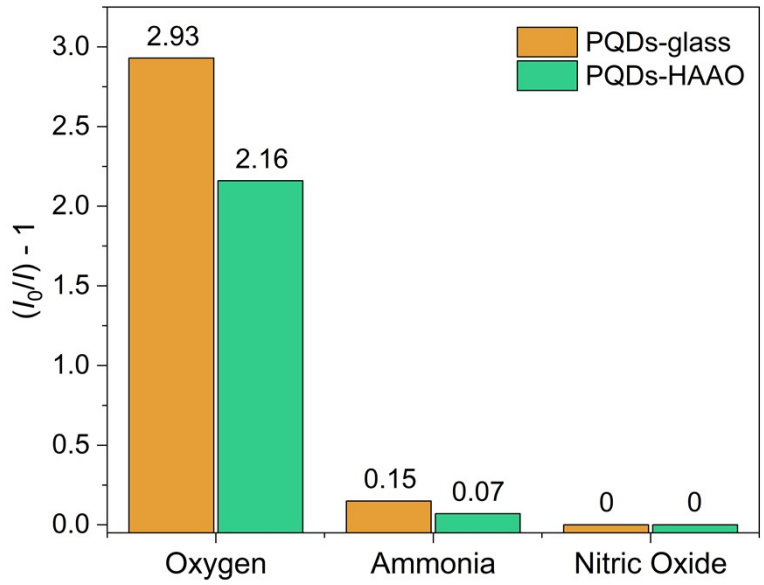

Fig. S6 Response of the sensor to different gases of oxygen (100%), ammonia (1000 ppm), and nitric oxide of (1000 ppm).

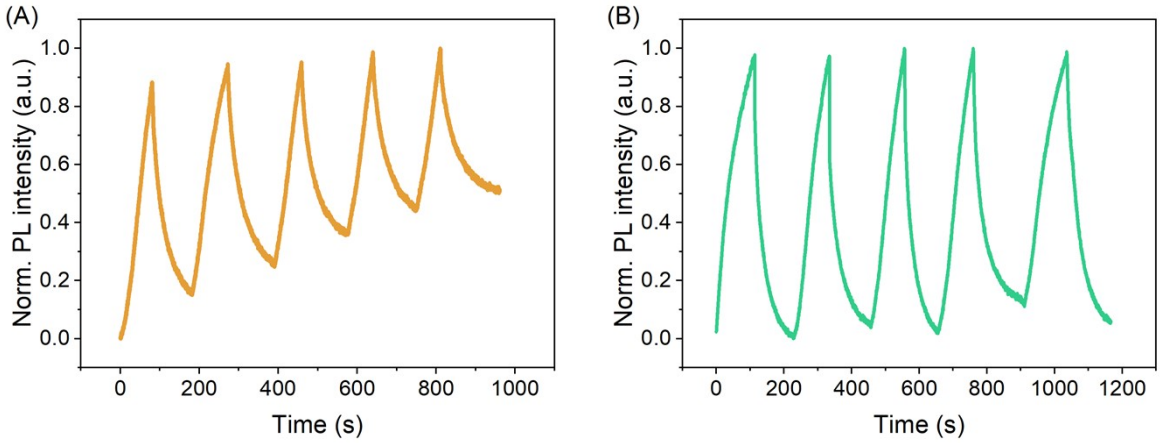

Fig. S7 Five cycles of response and recovery obtained by repetitively switching between 100% O_2 and 100% N_2 for (A) PQDs-glass and (B) PQDs-HAAO sensors.

Table S1. Summary of fitting results using second order Stern-Volmer plot.

Parameters	PQDs-glass	PQDs-HAAO
Equation	$\frac{I_0}{I} = 1 + (K_D + K_s)[Q]) + K_D K_S [Q]^2$	
K_S	-0.00499 ± 0.00032	-0.00396 ± 0.00018
K_D	0.0668 ± 0.00356	0.04196 ± 0.00117
Reduced Chi-Square	0.01401	0.00133
R-Square	0.99065	0.99841

Table S2. Comparison of the current work and previously reported fluorescent perovskite-based sensors.

Gas sensor	Gas type	Response time (s)	Recovery time (s)	Long-term Stability (hours)	References
$FAPbI_3$	NO_2	2	22	72	Ref.[1]
$CsPbBr_3$ QDs	H_2S	278	730	216	Ref.[2]
$MAPbBr_3$	NH_3	7	73	NA	Ref.[3]
$MAPbBr_3$ QDs	NH_3	1000	1000	NA	Ref.[4]
$MAPbBr_3$-TBA	NH_3	61	65	NA	Ref.[5]
$CsPbBr_3$	NH_3	8	780	96	Ref.[6]
$FAPbBr_3$ QDs-HAAO	O_2	83.9	113.3	504	This work

Table S3. Detail-fitted parameters of the TRPL decay curves for **Fig. 7**.

Sample	A_1	τ_1 (ns)	A_2	τ_2 (ns)	A_3	τ_3 (ns)	τ_{avg} (ns)
PQDs-glass fresh	0.25	9.04	0.38	53.69	0.37	188.63	154.35
PQDs-glass after 2 weeks	0.58	3.24	0.39	10.65	0.03	37.94	13.12
PQDs-HAAO fresh	0.36	9.39	0.45	46.06	0.18	140.05	91.85
PQDs-HAAO after 2 weeks	0.41	9.19	0.42	38.52	0.16	121.88	77.03

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