

## **Supporting Information**

# **Highly Sensitive Detection of Bladder Cancer-Related miRNA in Urine Using Time-Gated Luminescent Biochip**

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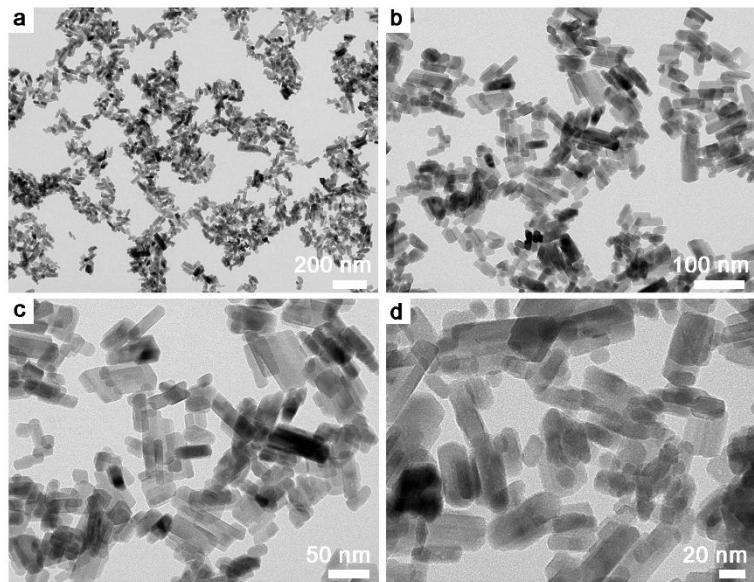
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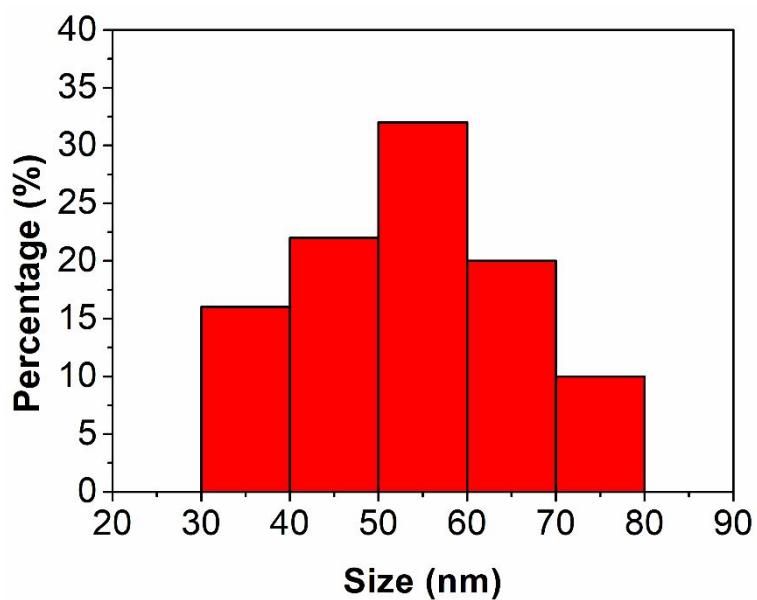
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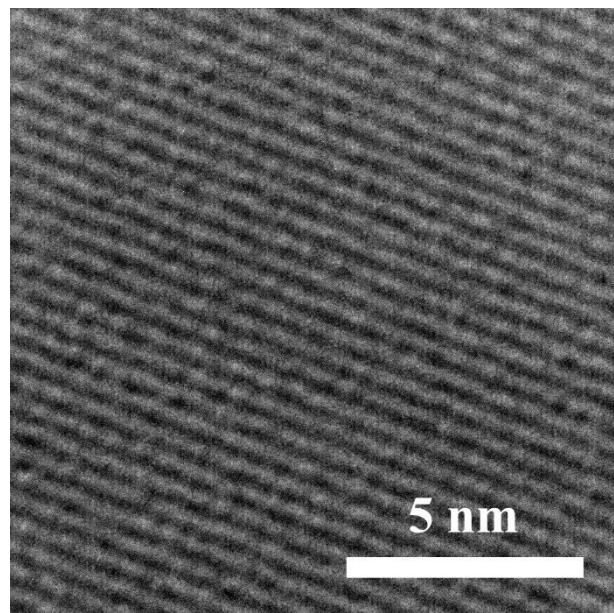
## Supplementary Figures



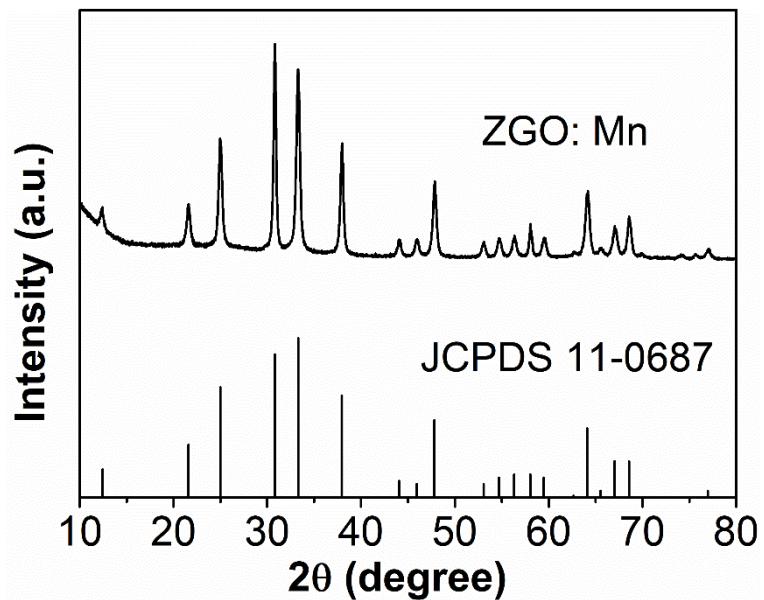
**Figure S1.** TEM images of ZGO:Mn LLNPs with different magnifications.



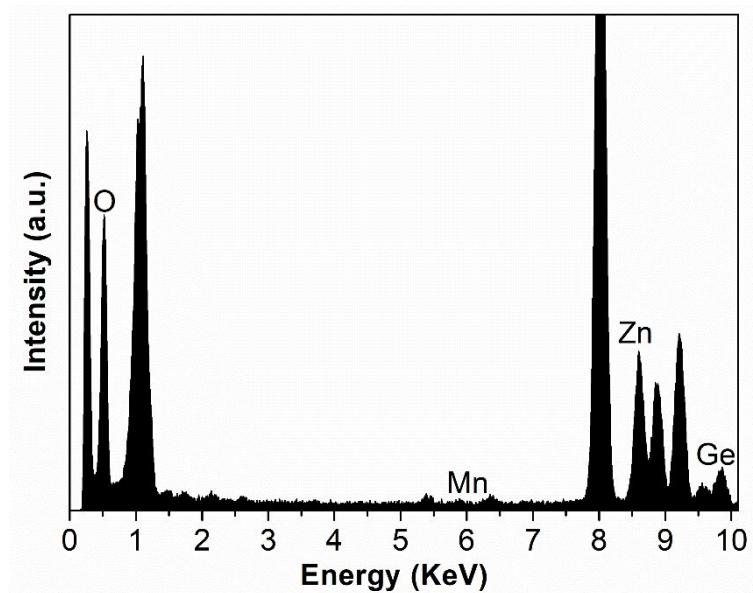
**Figure S2.** Statistical analysis of the size of ZGO:Mn LLNPs by TEM.



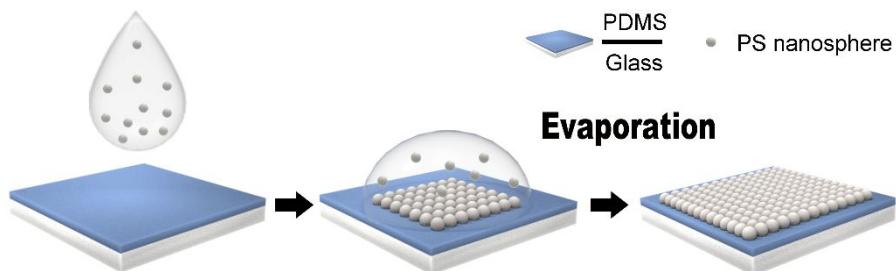
**Figure S3.** HRTEM image of ZGO:Mn LLNPs.



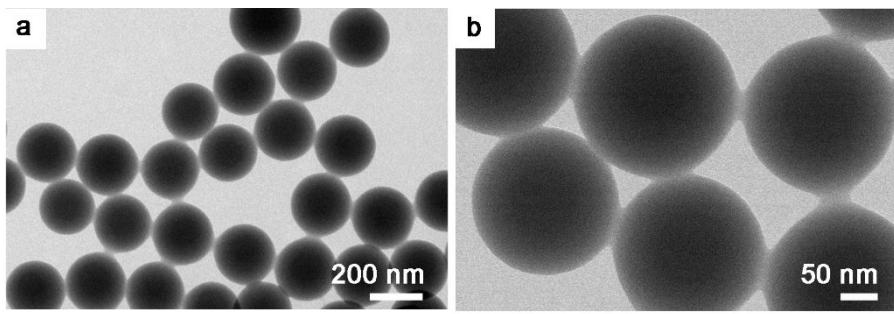
**Figure S4.** X-ray diffraction (XRD) patterns of ZGO:Mn LLNPs.



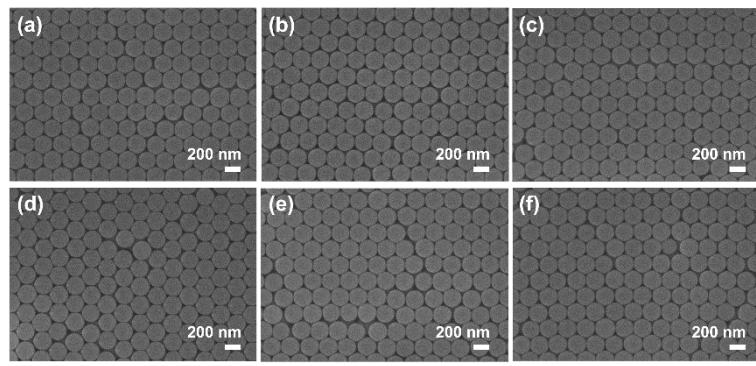
**Figure S5.** Energy-dispersive X-ray (EDX) analysis of the ZGO:Mn LLNPs.



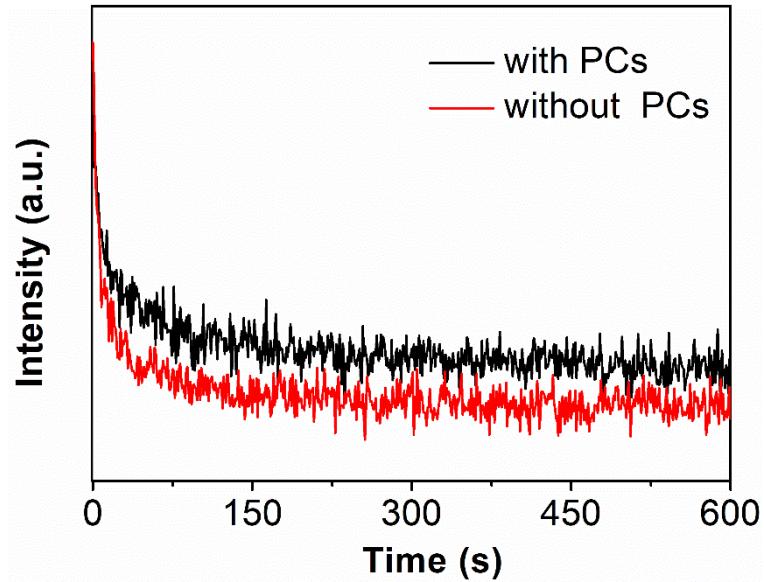
**Figure S6.** Illustration of the fabrication of PC substrate.



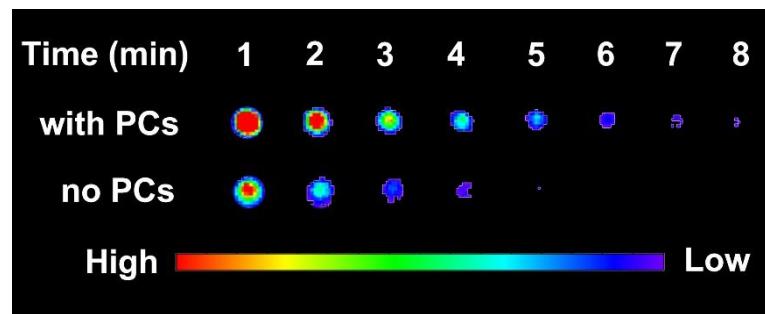
**Figure S7.** (a) Low-magnification and (b) high-magnification TEM images of PS nanospheres.



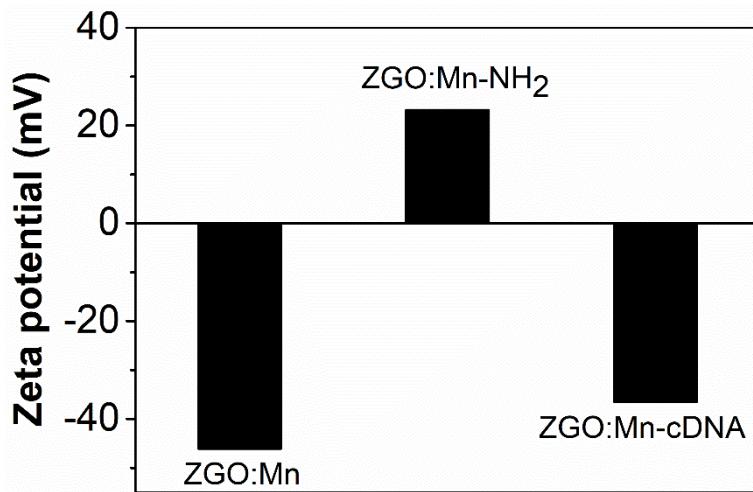
**Figure S8.** (a-f) SEM images of six different batches of photonic crystals.



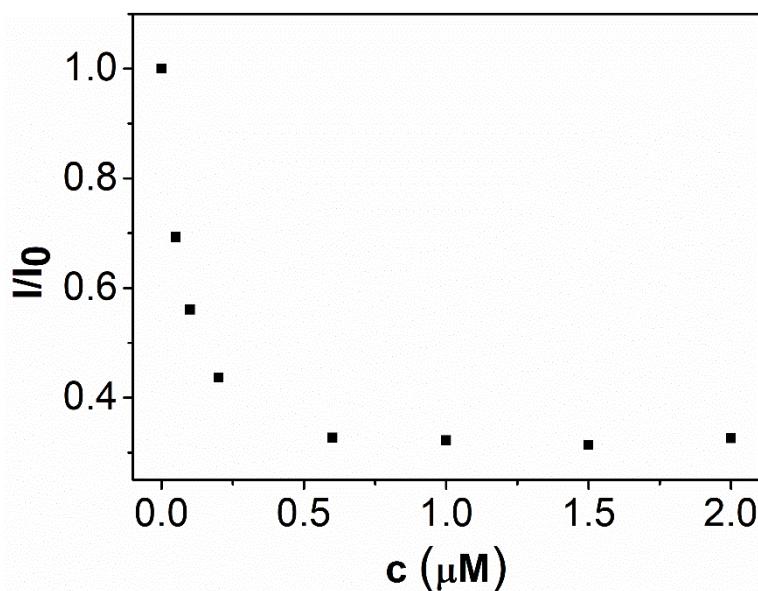
**Figure S9.** Long-lifetime luminescence decay of ZGO:Mn LLNPs supported with or without PCs.



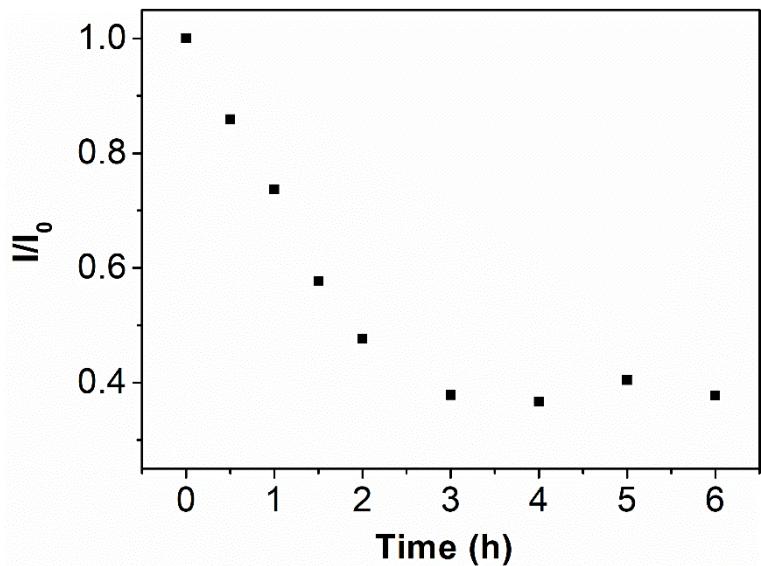
**Figure S10.** Images of the luminescence decay of LLNPs with PCs supports and without PCs supports.



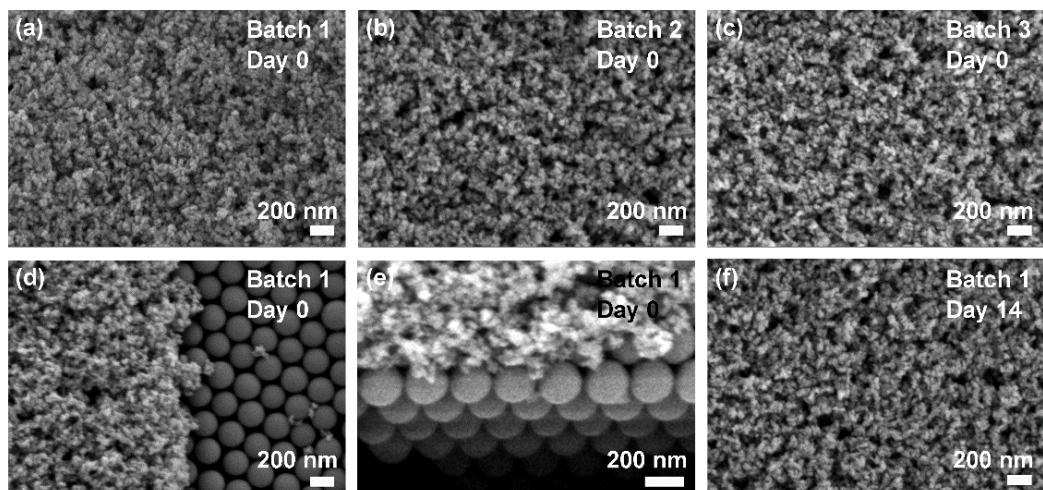
**Figure S11.** Zeta potential of ZGO:Mn, ZGO:Mn-NH<sub>2</sub> and ZGO:Mn-cDNA.



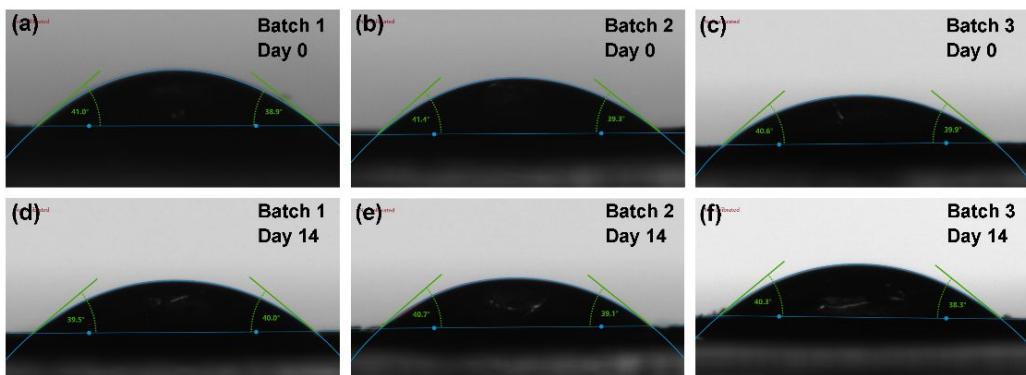
**Figure S12.** Long-lifetime luminescence changes of cDNA-functionalized ZGO:Mn LLNPs with different concentrations of BHQ-DNA.



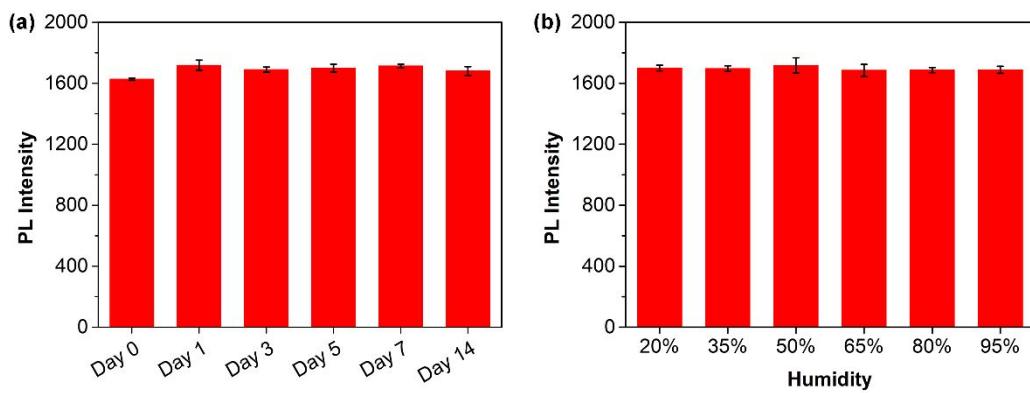
**Figure S13.** Long-lifetime luminescence changes of cDNA-functionalized ZGO:Mn LLNPs at different hours of adding 0.6  $\mu$ M of BHQ-DNA.



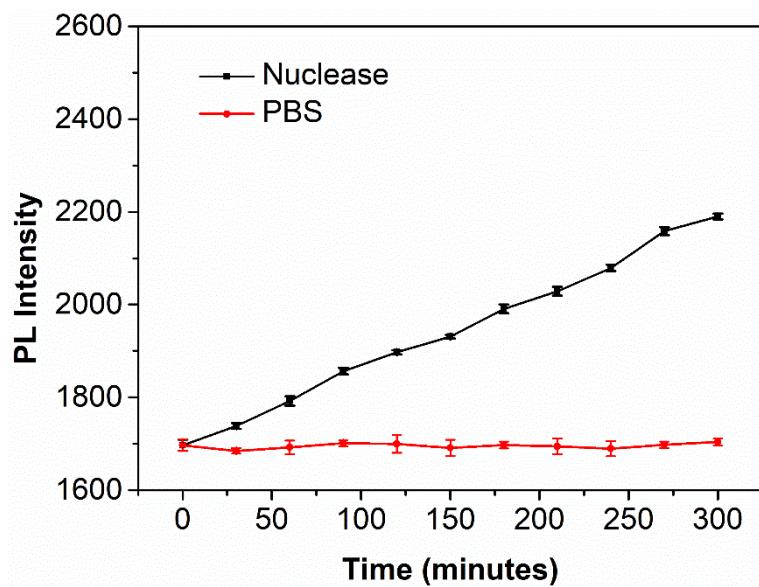
**Figure S14.** (a-c) SEM images of different batches of biochip. (d) SEM image of the margin of luminescent probes and PCs substrate. (e) SEM image of the section of the biochip. (f) SEM image of biochip after storing at room temperature for 14 days.



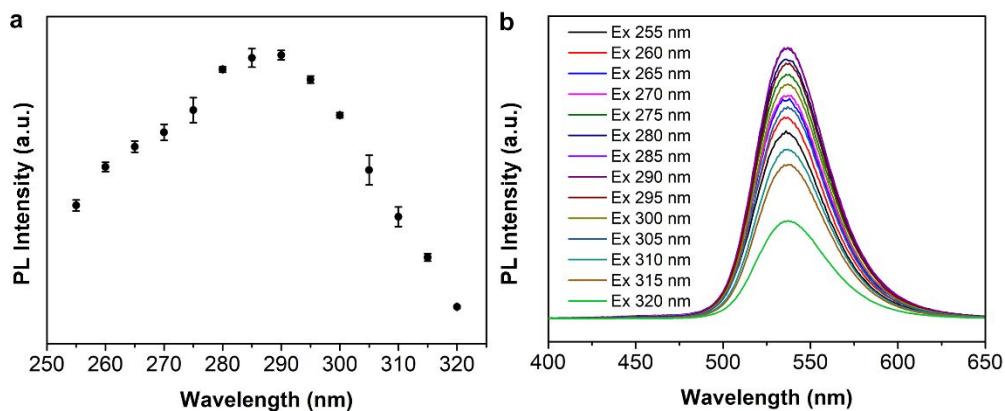
**Figure S15.** (a-c) Contact angle characterization of different batches of biochips. (d-f) Contact angle characterization of the biochips after storing at room temperature for 14 days.



**Figure S16.** (a) The long-lifetime luminescence intensity of biochips after storing for different days. (b) The long-lifetime luminescence intensity of biochips after storing at room temperature and different humidity for 24 h. Data are means  $\pm$  s.d. ( $n=3$ ).



**Figure S17.** The long-lifetime luminescence intensity of biochips after treating with nuclease. PBS was used as the control. Data are means  $\pm$  s.d. ( $n=3$ ).



**Figure S18.** (a) Luminescence intensity at 535 nm of the luminescent probe excited by different wavelengths. Data are means  $\pm$  s.d. ( $n=3$ ). (b) Luminescence spectra of the luminescent probe excited by different wavelengths.

**Table S1.** Comparison of our methods to other previously reported assays.

Target type	Target length (bp)	Donor	Acceptor	LOD	Ref.
miRNA	22	UCNPs	Au	0.12 fmol/10 <sup>6</sup> cells	1
				0.03 fmol/10 <sup>6</sup> cells	
mRNA	51	Cy5	Au	0.2~0.3 fmol	2
mRNA	30	FAM	TAMRA	nM level	3
miRNA	22	QD	Au NPs	4.56 pM	4
mRNA	22	FAM	Dabcyl	3.3 pM	5
ssDNA	32	cationic conjugated polyelectrolyte	fluorescein	2.14 pmol	6
	21			0.75 pmol	
ssDNA	20	rhodamine	Cy5	0.25 pM	7
miRNA	22	magentic fluorescent nanoparticles	BHQ1	100 pmol	8
ssDNA	25	two-photon excitation molecule	BHQ1	~0.08 μM	9
miRNA	22	longlifetime luminescence nanoparticles	BHQ2	26.3 fM	Our study

## Reference

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10.1021/ac902467w.