ADVANCED HEALTHCARE MATERIALS

Supporting Information

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Rapid Optical Cavity PCR

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Supporting Information

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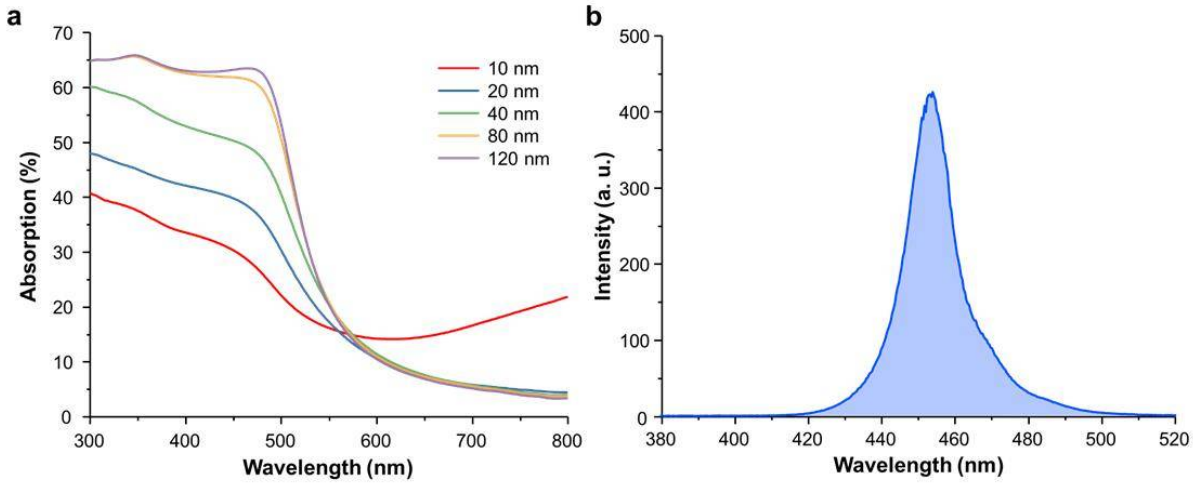
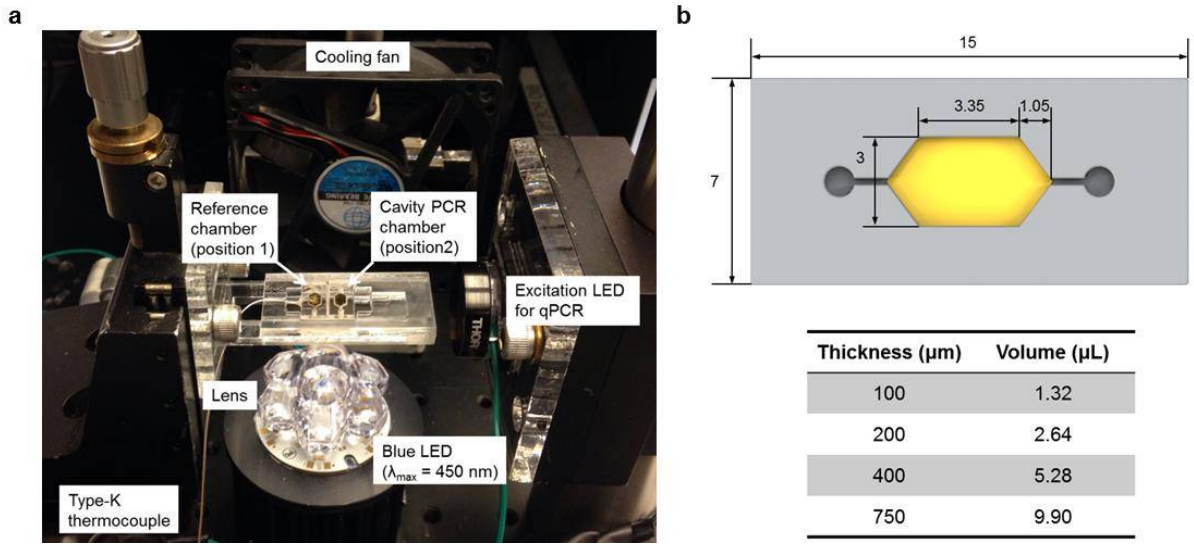


Figure S1. a, Absorption spectra of the thin Au films with different thicknesses. b, Emission spectrum of blue LEDs used for photothermal heating of the thin Au film.



Thickness (μm)	Volume (μL)
100	1.32
200	2.64
400	5.28
750	9.90

Figure S2. a, Photograph of the experimental setup for the LED-driven optical cavity PCR. Injection current is 1 A. b, Dimensions of the cavity PCR chamber (in mm) with different thicknesses for different volumes of PCR mixture, ranging from 1.32 μL to 9.90 μL.

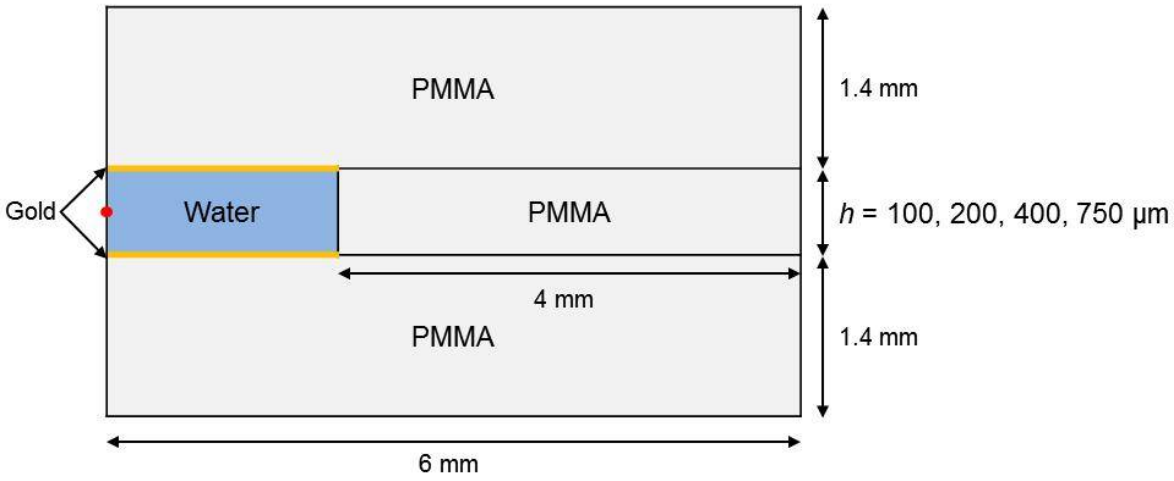


Figure S3. Geometry for the simulation of temperature distribution in the optical cavity PCR chamber. The thickness of the chamber varied from 100 to 750 μm. The temperature was monitored at the middle of the chamber (red dot, 0 μm on x-axis and h/2 μm on z-axis for each thickness).

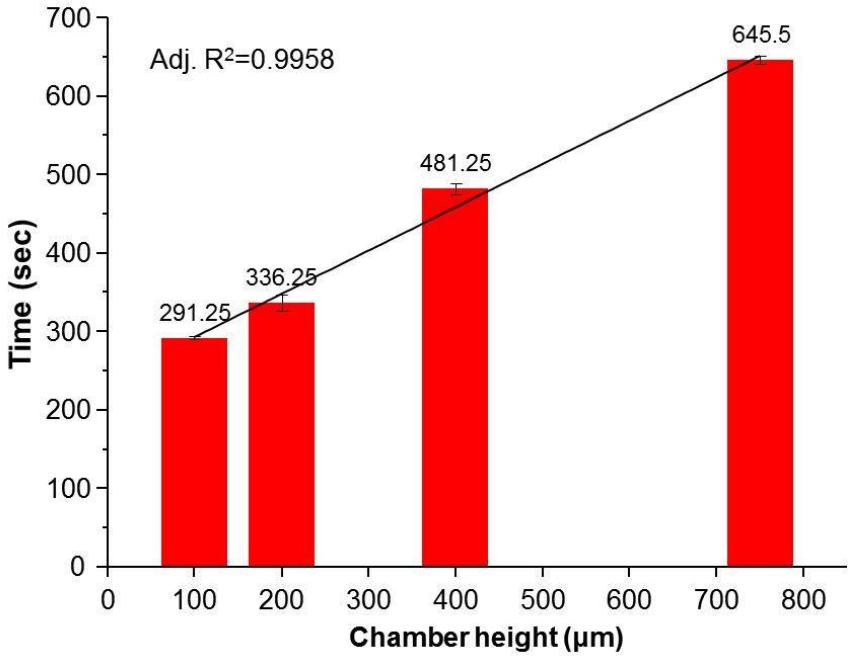


Figure S4. Time for 30 PCR thermal cycles obtained from bottom-only heating with different chamber heights.

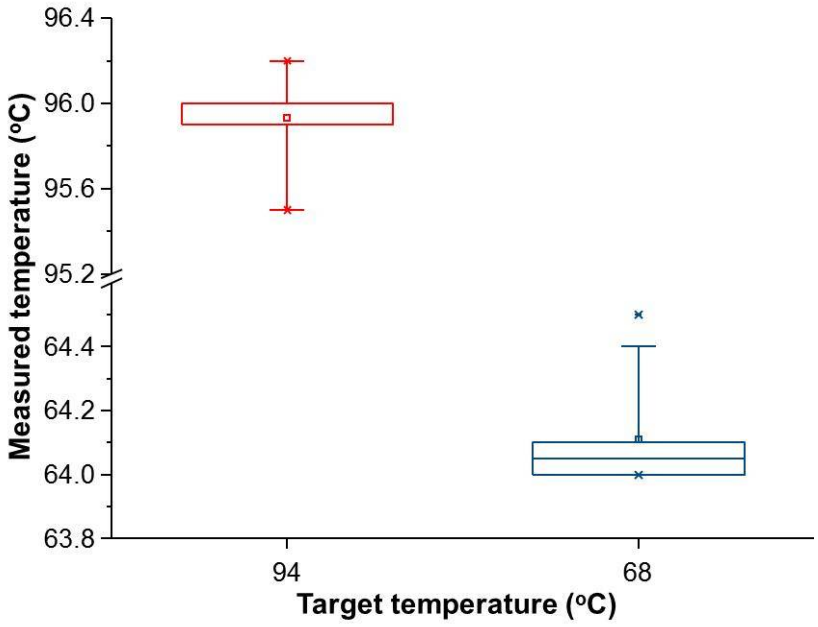


Figure S5. Comparison between target and measured temperatures (sample temperature on the display) from the benchtop thermal cycler. Thermal cycling conditions: 1 sec at 94 °C, 1 sec at 68 °C, 30 cycles. Total reaction time: 15 min 40 sec.

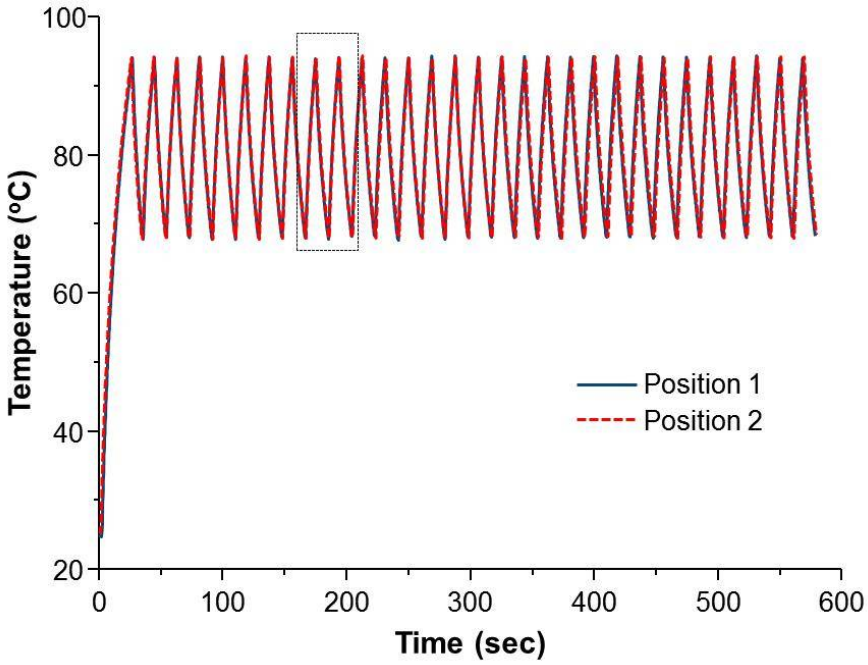


Figure S6. Temperature profiles for the 30 thermal cycles of the cavity PCR chamber at positions 1 and 2. Fig. 3e shows the enlarged rectangle region.

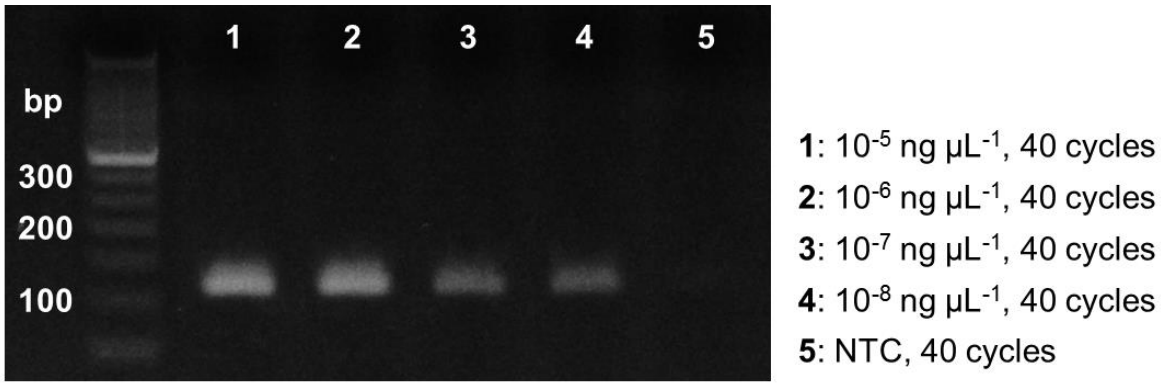


Figure S7. Results of 2% agarose gel from the benchtop PCR demonstrating the trend in band intensity with different concentrations of initial c-MET cDNA. A thermal cycling protocol recommended by the manufacturer was used: initial denaturation was at 95 °C for 3 min, 40 cycles for 15 sec at 95 °C (denaturation), 15 sec at 60 °C (annealing), and 1 sec at 72 °C (extension), final extension at 72 °C for 6 sec.

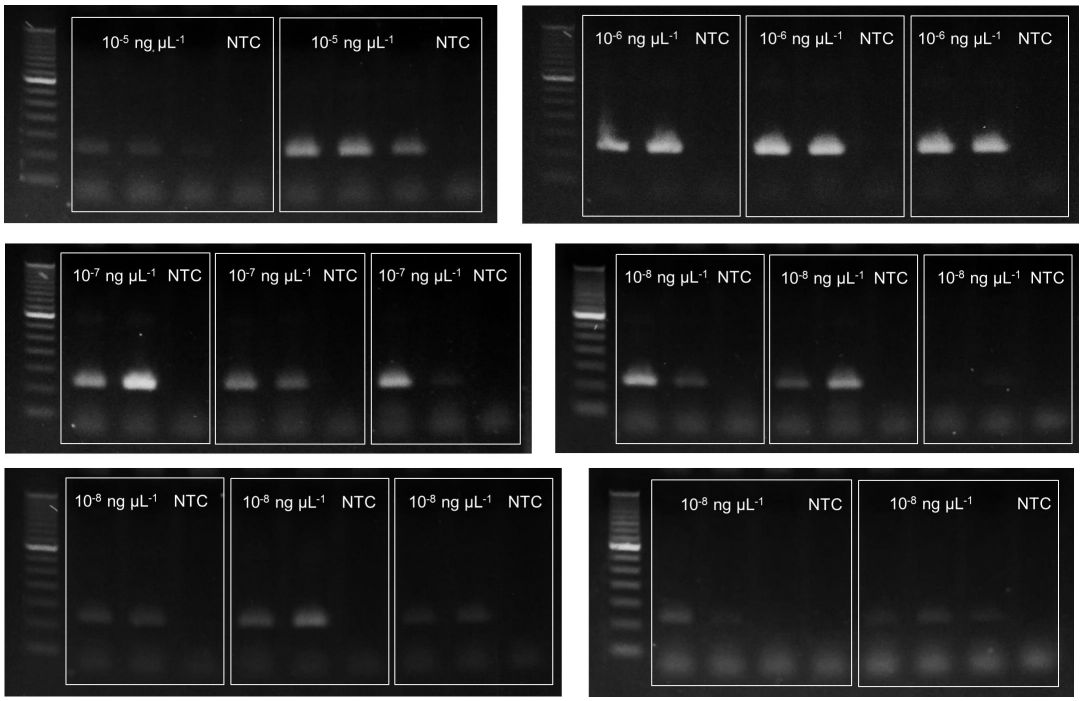


Figure S8. Images of 2% agarose gel with different concentrations of initial c-MET cDNA ranging from 10^{-5} ng µL^{-1} to 10^{-8} ng µL^{-1} for the calculation of the PCR success rate (Figure 4f) to show the repeatability and reproducibility of cavity PCR.

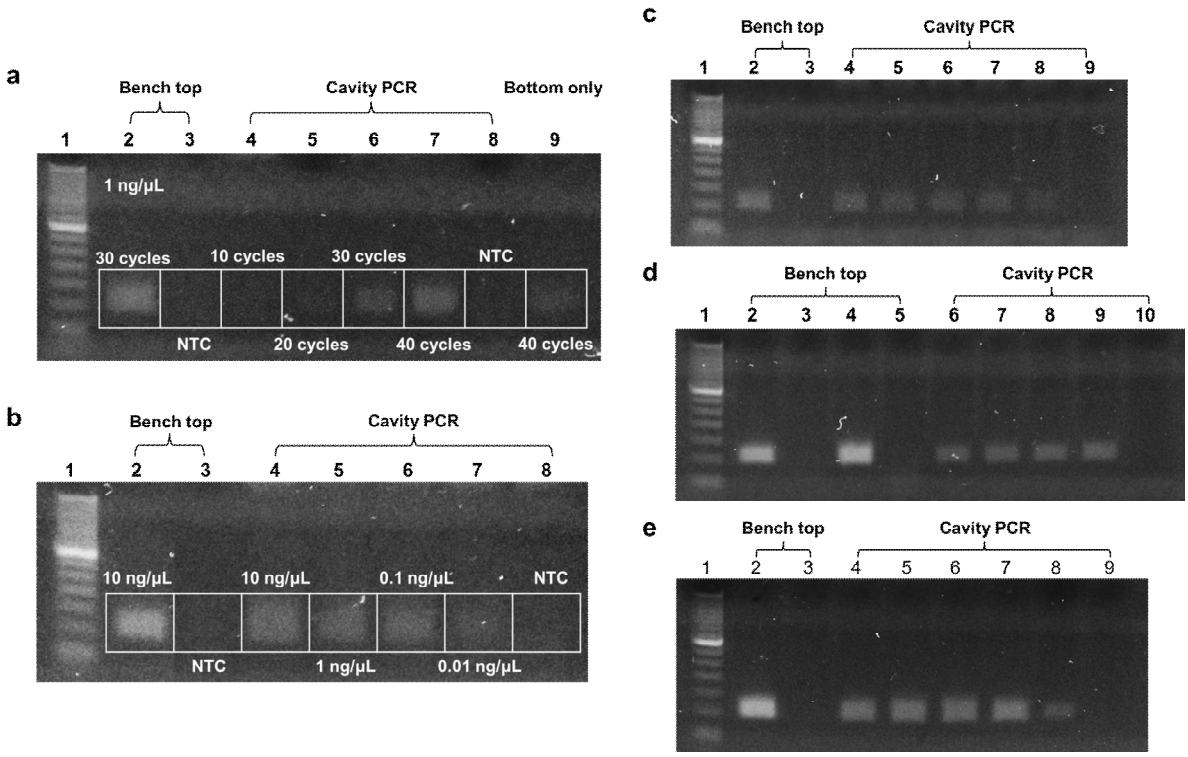


Figure S9. a, Results of 2% agarose gel demonstrating a clear trend of increased PCR product

with increased thermal cycling number. Amplification in the cavity PCR shows a higher band intensity than in the bottom-only heating PCR for 40 cycles, indicating better amplification efficiency of the cavity PCR due to enhanced temperature uniformity. b, Results of 2% agarose gel demonstrating a trend in band intensity with increasing initial λ-DNA concentration. c, d, e, Results of 2% agarose gel demonstrating the repeatability and reproducibility of the optical cavity PCR when performed by three minimally trained undergraduate students.

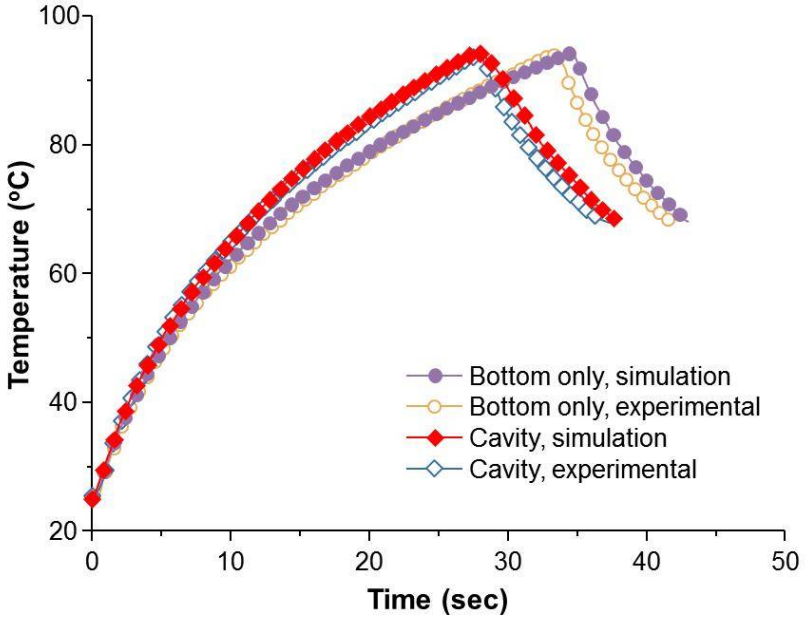


Figure S10. Comparison of temperature profiles between simulation and experimental results during the first heating and cooling cycles. The chamber height is 750 μm.

Table S1. Averaged transmittance (T), reflectance (R) and absorbance (A) of the thin Au film over the emission wavelengths of LEDs with different thicknesses. Absorbance (%) = 100 – Transmittance (%) – Reflectance (%).

Au thickness	T (%)	R (%)	A (%)
10 nm	50.6	19.7	29.7
20 nm	29.6	31.2	39.2
40 nm	10.6	39.6	49.8
80 nm	1.1	37.4	61.5
120 nm	0.1	36.8	63.1

Table S2. Material parameters for the heat transfer simulation.

	Density ρ (kg m^{-3})	**Heat capacity** C (J kg^{-1} K^{-1})	**Thermal conductivity** k (W m^{-1} K^{-1})
Gold	19,300	129	317
PMMA	1,190	1,420	0.19
Water	998	4,180	0.6