Electronic Supplementary Material (ESI) for Lab on a Chip.

Supporting information

Development of a self-powered digital microfluidic chip (SP-dChip) for the detection of emerging viruses

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Figure S1. The fabrication and storage of microfluidic chips. (a) The PDMS elastomer and curing agent are mixed at a ratio of 10:1 and poured onto the master mold. (b) The PDMS is degassed using a vacuum pump. (c) After incubation, the PDMS slab is cut and removed. (d) Individual chips are excised and isolated. (e) Chips are bound to standard microscope slides via oxygen plasma treatment. (f) Vacuum-sealable bags are prepared for vacuum sealing. (g) The chips are vacuum sealed. (h) The chips are stored in vacuum-sealable bags until use.

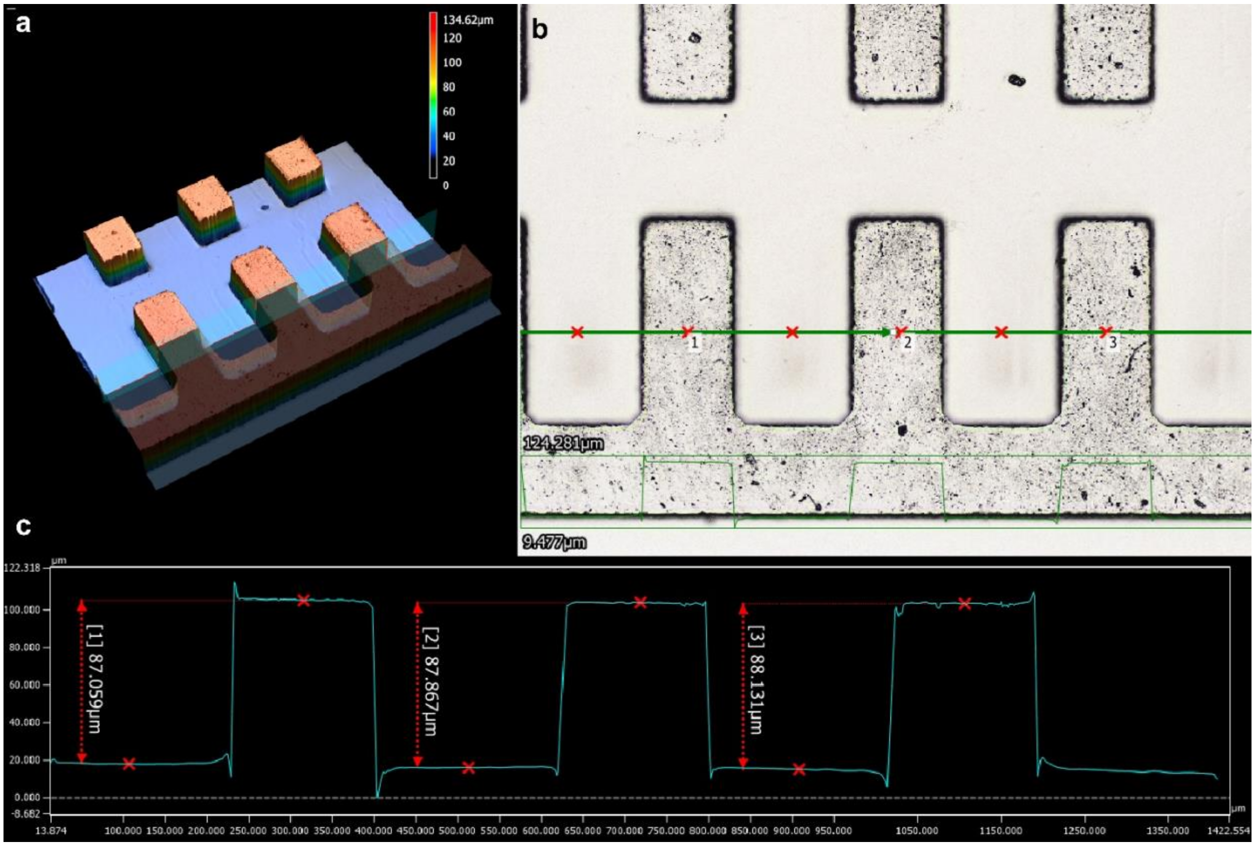

Figure S2. Dimensions and analysis of microfluidic wells. (a) 3D view and depth measurement of the microfluidic wells using a profilometer. (b) Top-down measurement of microfluidic well width. (c) Side-view measurement of the microfluidic well depth.

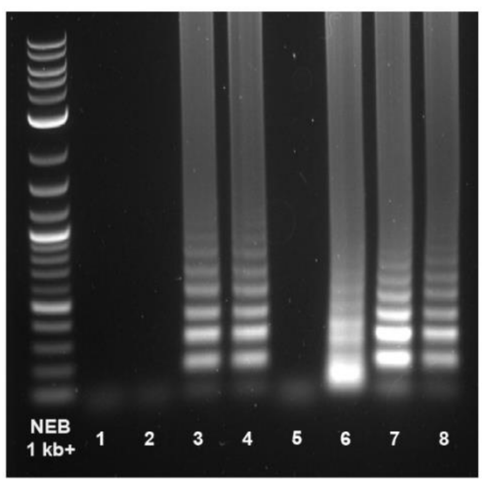

Figure S3. Optimization of four ZIKV LAMP primer sets. The tests were performed with a negative control (-) and 10^3 ZIKV RNAs (+). (1: Primer set P1 without target, 2: Primer set P1 with target, 3: Primer set P2 without target, 4: Primer set P2 with target, 5: Primer set P3 without target, 6: Primer set P3 with target, 7: Primer set P4 without target, 8: Primer set P4 with target)

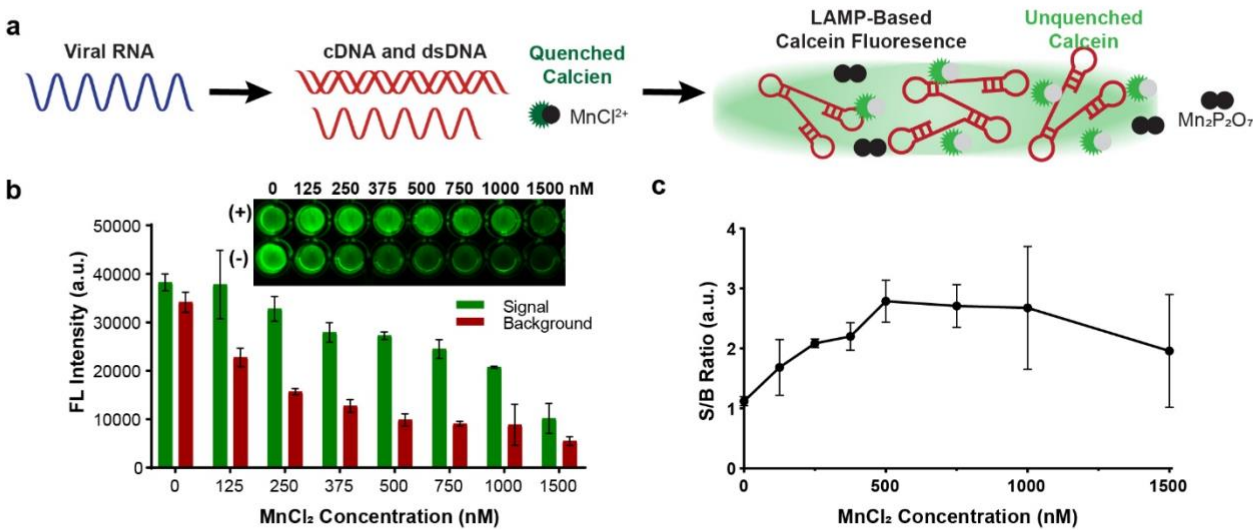

Figure S4. Optimization of calcein-based LAMP fluorescent assays. (a) Schematic illustration of calcein LAMP fluorescent method. (b) Photograph and fluorescent intensity of positive ZIKV LAMP amplification with 10^3 ZIKV RNAs (signal) and no amplification controls (background) using 12.5 nM calcein with varying concentrations of $MnCl_2$. (c) Signal/background ratio for the ZIKV LAMP amplification using 12.5 nM calcein with varying concentrations of $MnCl_2$.

Table S1. Oligonucleotide sequences used for the LAMP assays

DNA Name	Sequence (5'-to-3')
LAMP Primers	
P1_ZIKV_FIP	TCAGGCCAACAGCTGTGAGTACGACTGCTGTTGCTCACA
P1_ZIKV_BIP	CGCATTGGCTGGAGGGTTCGTGACAATTAGCAGACCGACC
P1_ZIKV_F3	GACCCCATCAACGTGGTG
P1_ZIKV_B3	CCACACTCTTTCCTGAGACC
P1_ZIKV_LF	CAGCTCCGCTTCCCACT
P1_ZIKV_LB	AGGCAGATATAGAGATGGCTGG
P2_ZIKV_FIP	GGCATGTGCGTCCTTGAACTCTGACACCGGAACTCCACACT
P2_ZIKV_BIP	AGAAGGAGCAGTTCACACGGCCCCTTTGCACCATCCATCTC
P2_ZIKV_F3	TGGTTCCACGACATTCCATT
P2_ZIKV_B3	CATTTCAAGTGGCCAGAGGA
P2_ZIKV_LF	ACCAGTGCTTCTTTGTTGTTCC
P2_ZIKV_LB	CCTTGCTGGAGCTCTGGAG
P3_ZIKV_FIP	CCTGAGGGCATGTGCAAACCTAGAATGGCAGTCAGTGGAGAT
P3_ZIKV_BIP	ACCCTCAACTGGATGGGACAACTGGAGCTTGTTGAAGTGGTG
P3_ZIKV_F3	CGGATGGGATAGGCTCAAAC
P3_ZIKV_B3	ATGGACCTCCCGTCCTTG
P3_ZIKV_LF	CATCAATTGGCTTCACAACGC
P3_ZIKV_LB	GGGAAGAAGTTCCGTTTTGCTC
P4_ZIKV_FIP	TGACTCAGTGTCCTCTGAGGGTTTTCCTATAGTCAGGCCGAGAA
P4_ZIKV_BIP	GAGGCGCAGGATGGAAACACAGCTGATCTCCAGTTC
P4_ZIKV_F3	CTAGTCAGCCACAGCTTG
P4_ZIKV_B3	CTAACCACTAGTCCCTCTTCT
P4_ZIKV_LF	AGCATGGCTTCTTCCGTG
P4_ZIKV_LB	CCTTCCCCACCCTTCAATC

Table S2. Cost analysis of the SP-dChip for ZIKV detection

Material	Cost per assay
Polydimethylsiloxane (PDMS)	$1.33
RT-LAMP Master Mix	$0.89
LAMP Primers	<$0.01
Mineral oil	$0.02
Manganese Chloride ($MnCl_2$)	$0.01
Calcein	$0.25
Microscope slide	$0.14
Others (aluminum foil, pipette tip, $MgCl_2$)	<$0.01
Total	**$2.64**

Table S3. Summary of the performance of LAMP-based microfluidic chips

Device	Material	Target	Transduction method	Detection limit (copies/μL)
Hongwarittorrn 2017[1]	Paper	*E. coli*	HNB dye	4.14×10^3
Roy 2017[2]	Paper	*B. subtilis*	Crystal violet	2.2×10^3
Yao, 2021[3]	PDMS	DENV-4	Calcein	100
Nguyen, 2022[4]	PMMA	SARS-CoV-2	SYBR Green I	20
Wen, 2022[5]	PMMA	PEDV	NEB LAMP dye	100
Hu, 2023[6]	PMMA	WSV	EvaGreen	100
SP-dChip (this study)	**PDMS**	**ZIKV**	**Calcein**	**100**

References

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