Supplemental Information

Sensitive distance-based paper-based quantification of mercury ions using carbon nanodots and heating-based preconcentration

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1. Black box for Hg^{2+} detection

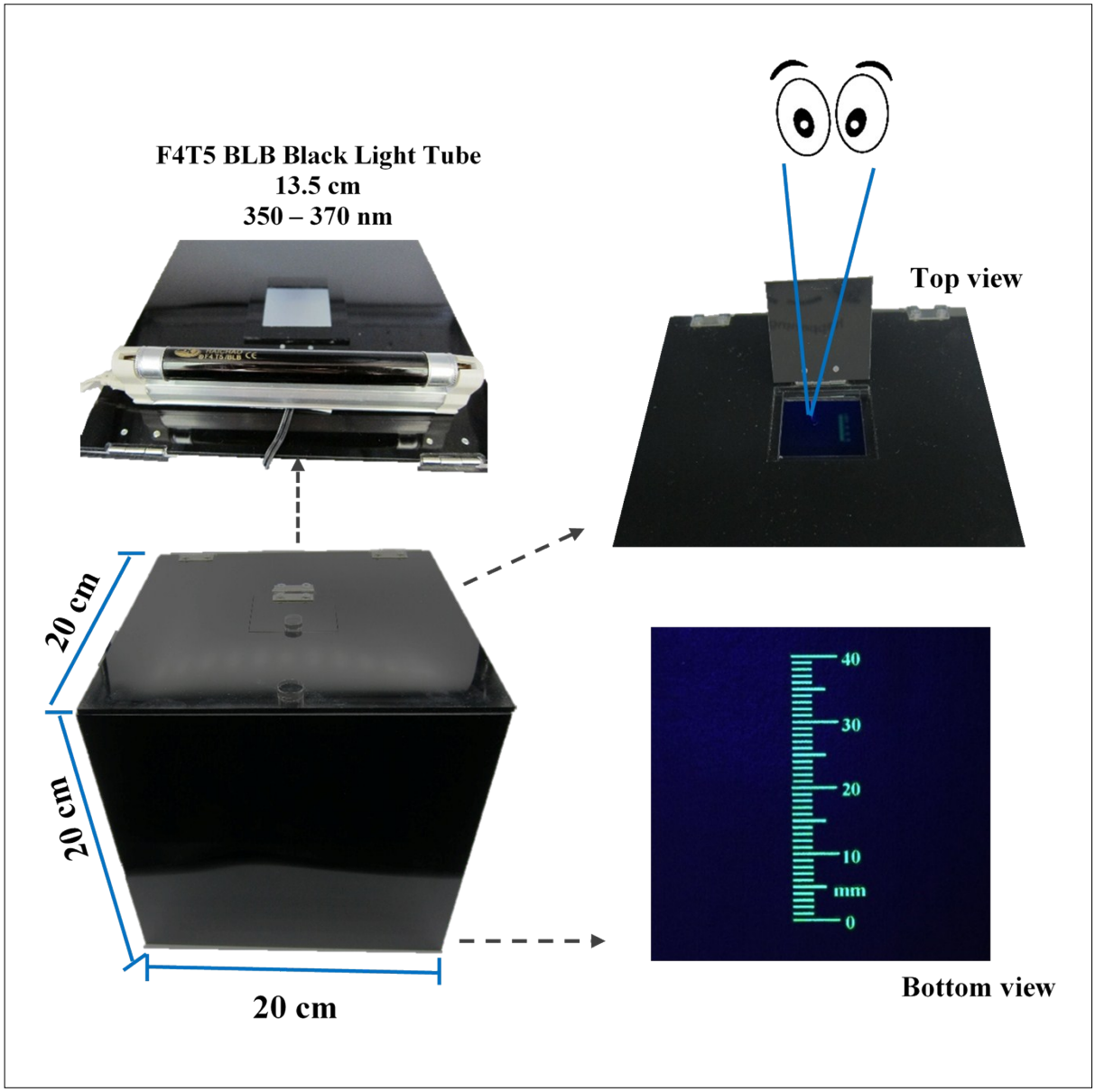


Fig. S1 Black box with luminous scale.

2. Characterization of NCDs by XRD

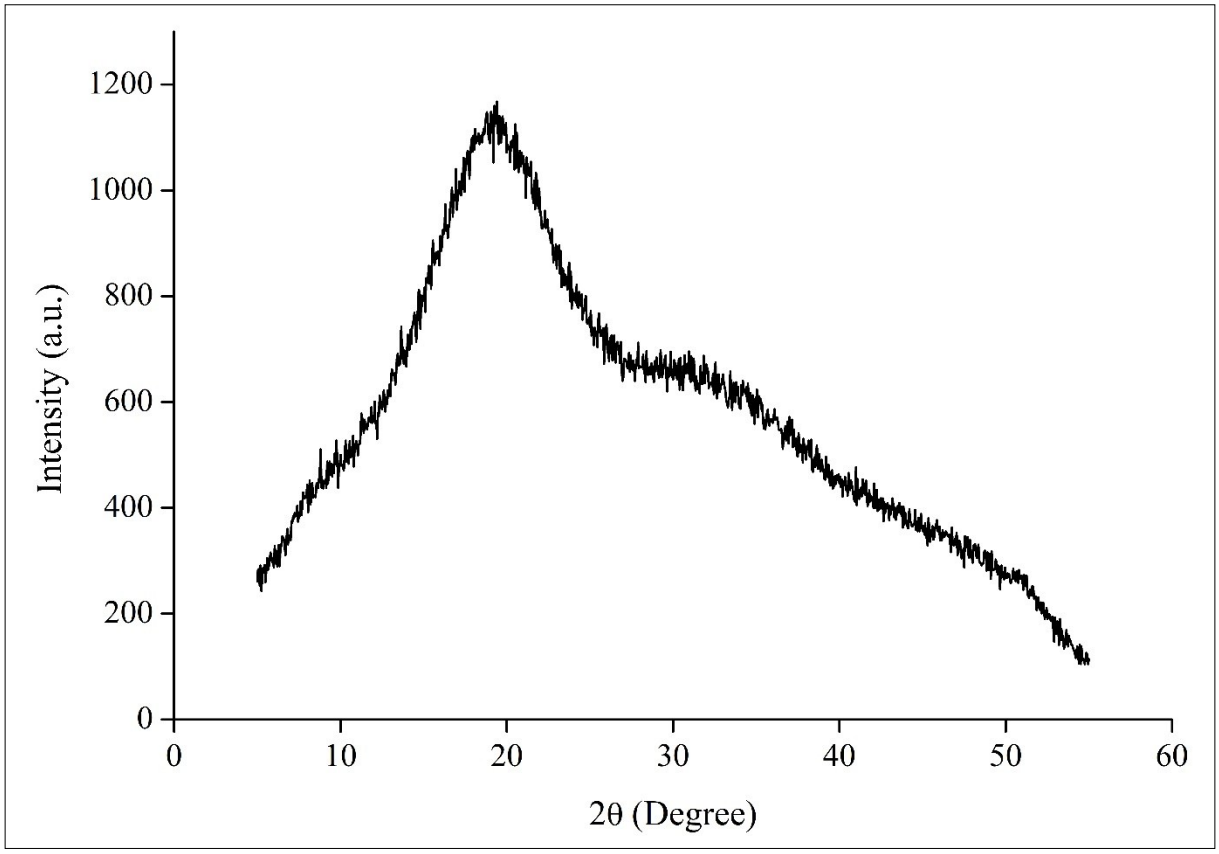


Fig. S2 XRD spectra at 2θ.

3. Characterization of NCDs by FT-IR

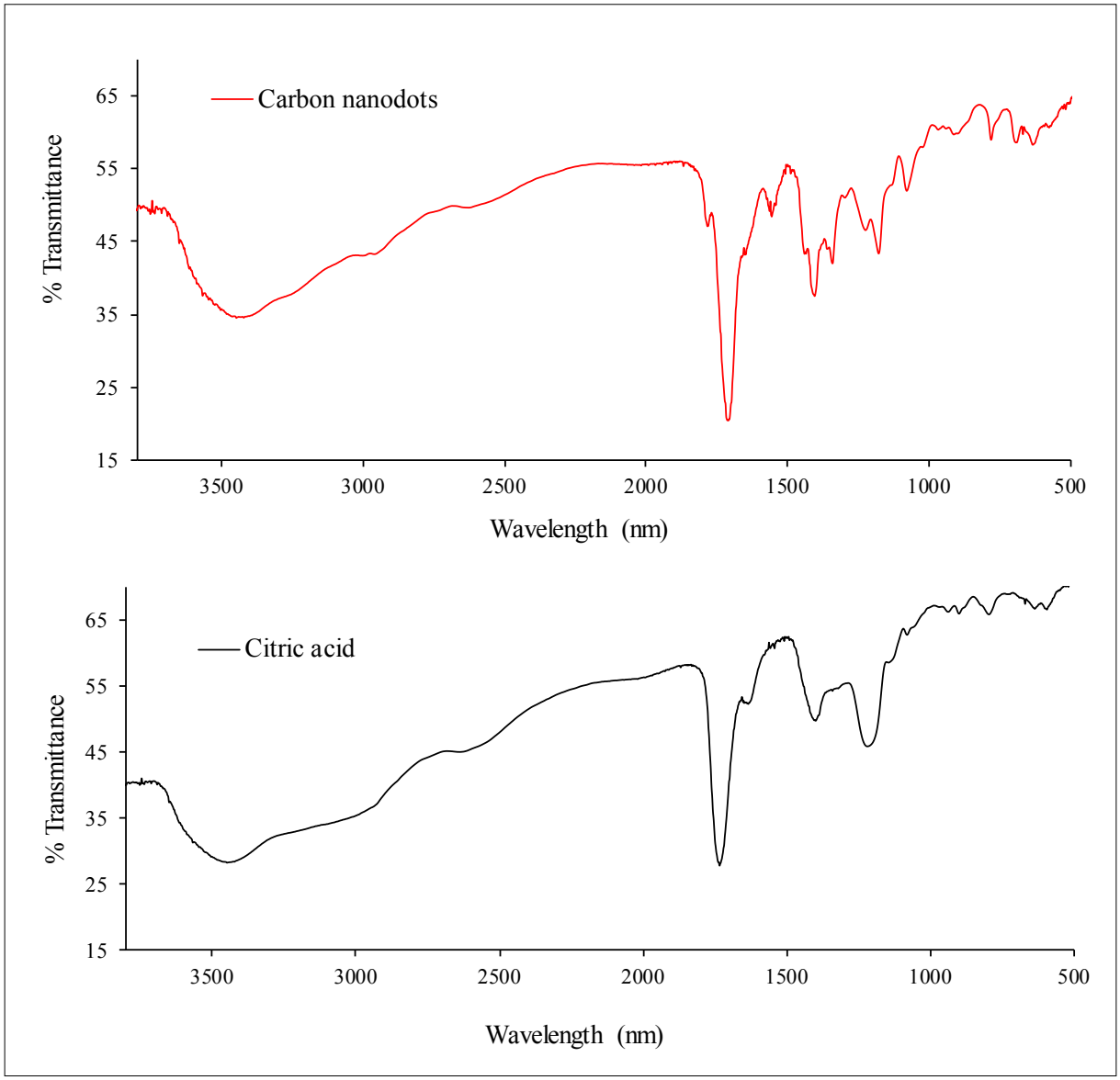


Fig. S3 FT-IR spectra with the comparison of carbon nanodots and citric acid.

4. Characterization of NCDs by TEM

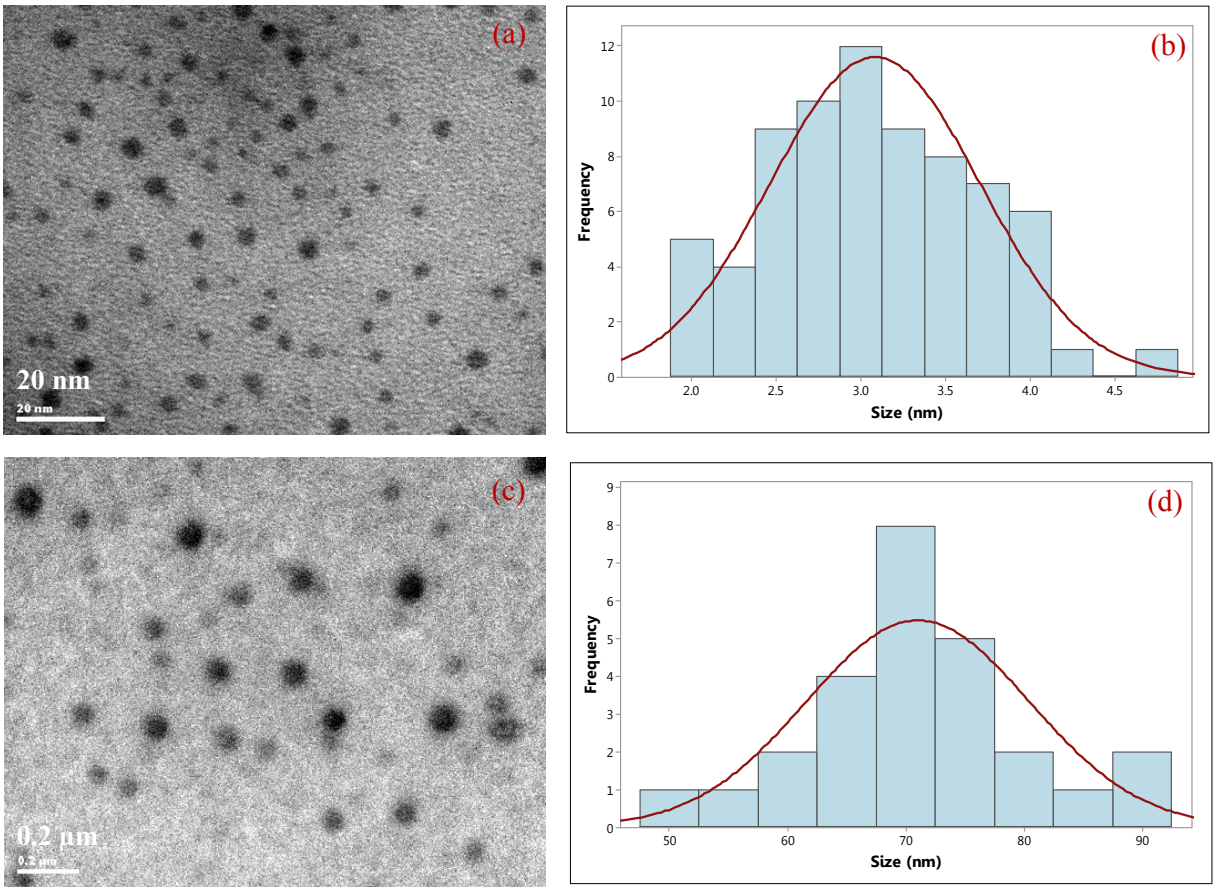


Fig. S4 TEM images for NCDs (a), particle size distribution of NCDs (b), NCDs NPs in the presence of 20 mg L^{-1} Hg^{2+} (c), and particle size distribution of NCDs with Hg^{2+} (d).

5. Paper type

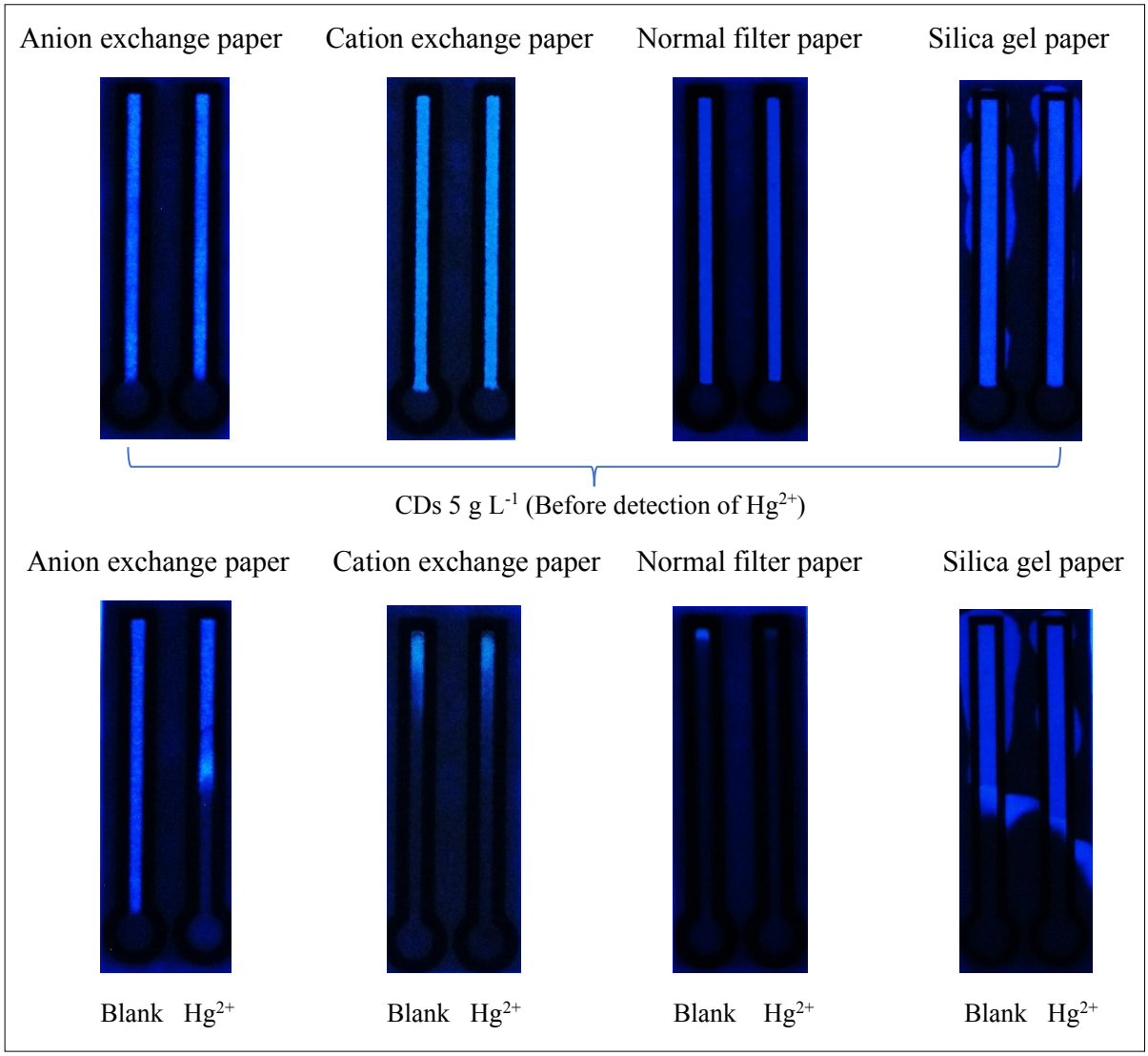
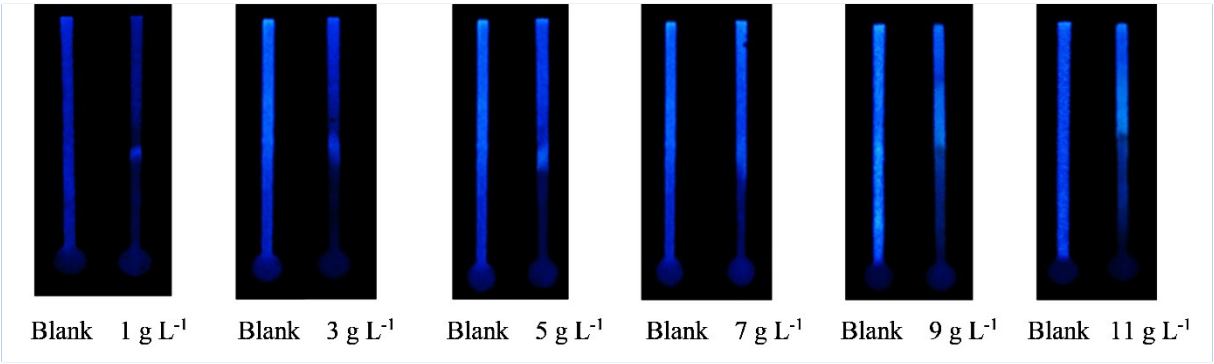


Fig. S5 Effect of paper type on fluorescent signal before and after addition of 10 mg L^{-1} Hg^{2+}.

6. The concentration of NCDs

(a)



(b)

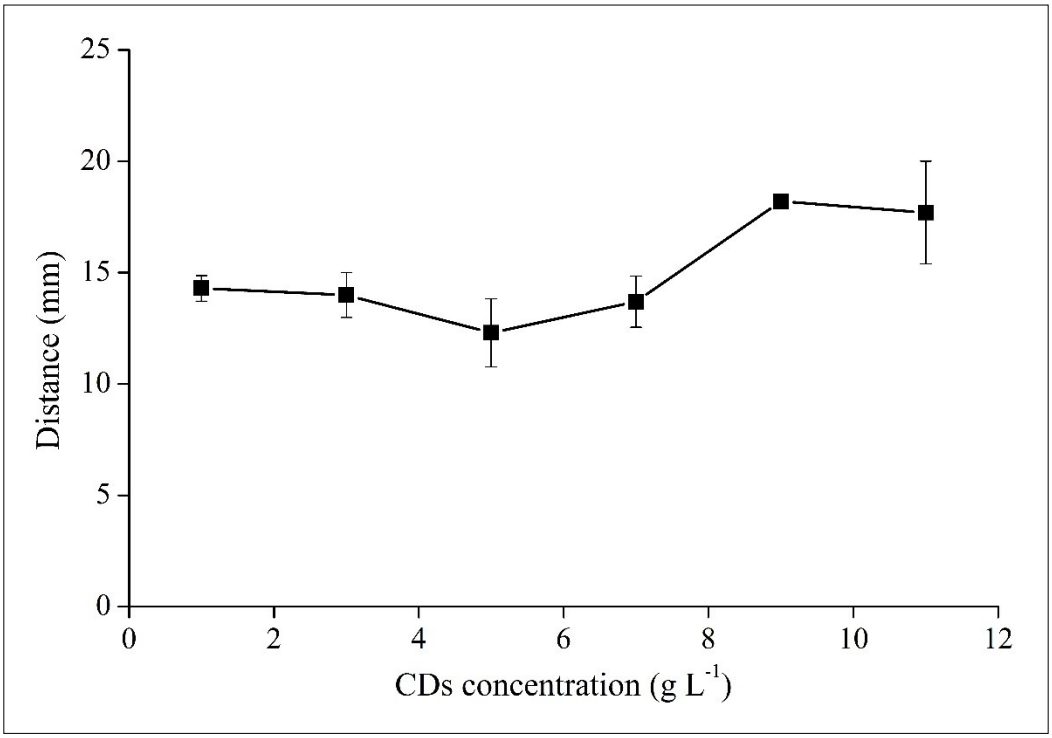
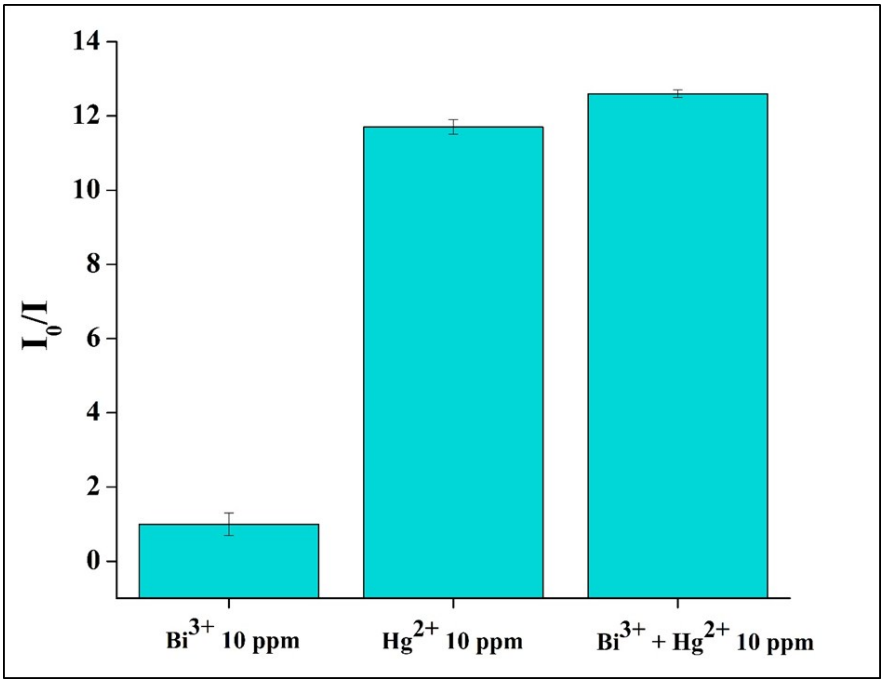


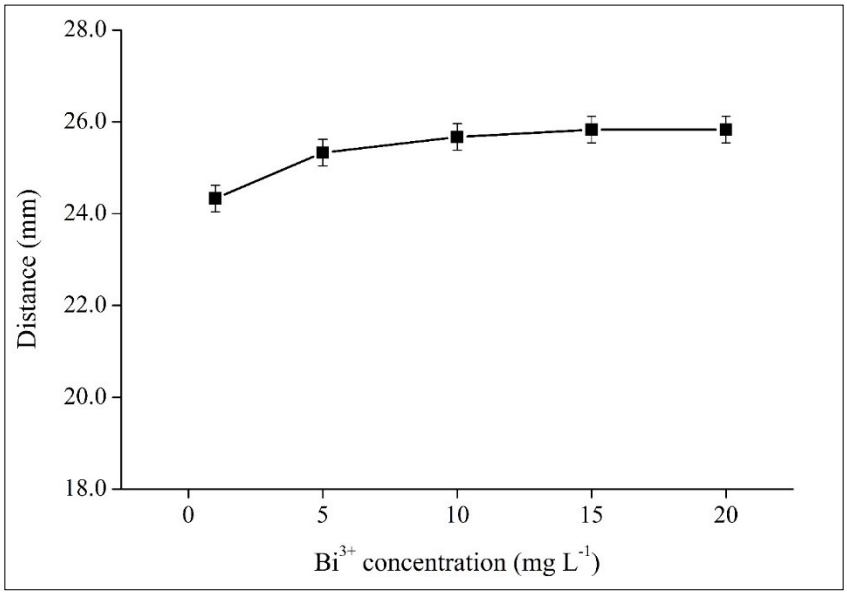
Fig. S6 Effect of NCD concentration in the range of 3 – 11 g L^{-1} with 10 mg L^{-1} of Hg^{2+}.

7. Bi^{3+} concentration

(a)



(b)



(c)

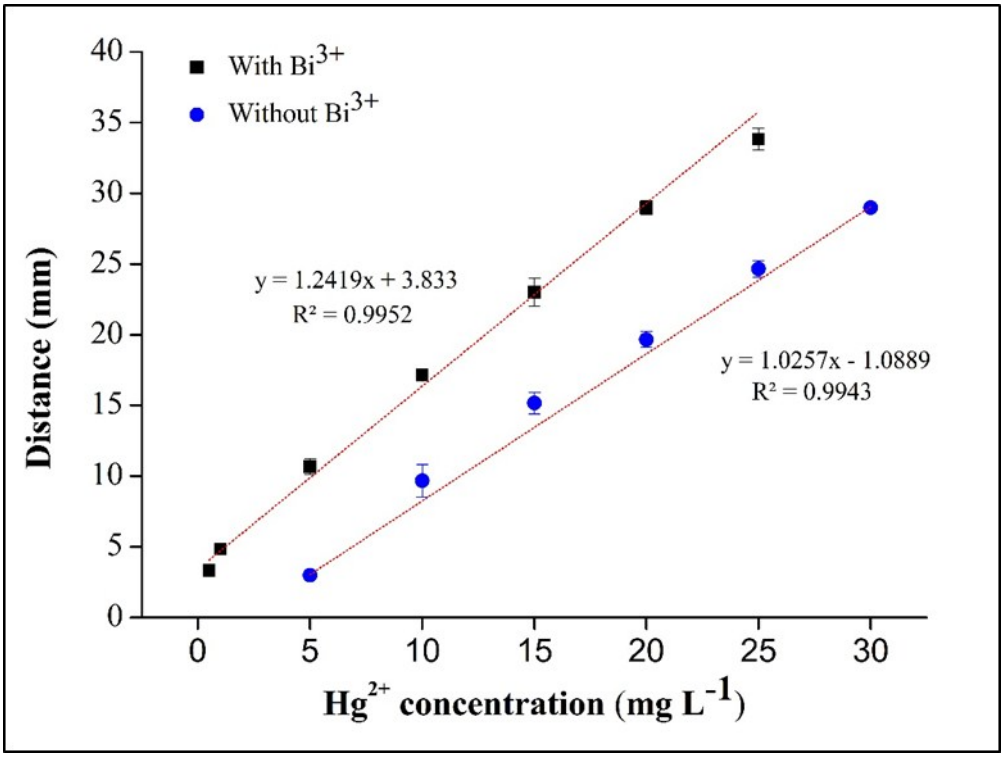


Fig. S7 Fluorescence intensity ratio of NCD before and after (I_0/I) addition of 10 mg L^{-1} Bi^{3+}, Hg^{2+} and the mixture of Bi^{3+} and Hg^{2+} at 350 nm excitation wavelength (a). Effect of Bi^{3+} concentration in the range of 1 – 20 mg L^{-1} with 10 mg L^{-1} of Hg^{2+} (b). Sensitivity of Hg^{2+} detection with and without Bi^{3+}

8. Interferences effect

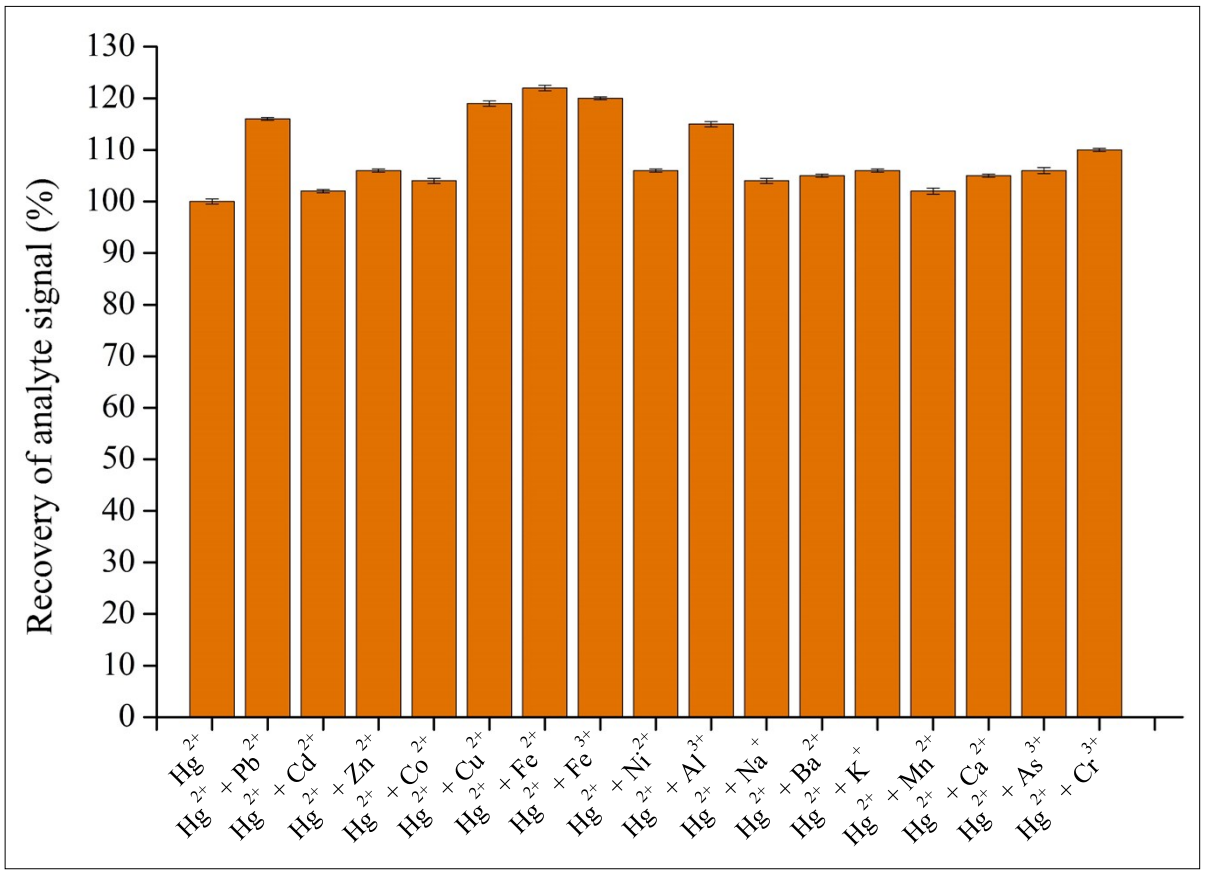


Fig. S8 Interferences effect with 1:100 ratio of analyte to interference with 10 mg L^{-1} of Hg^{2+}

9. Heating preconcentration

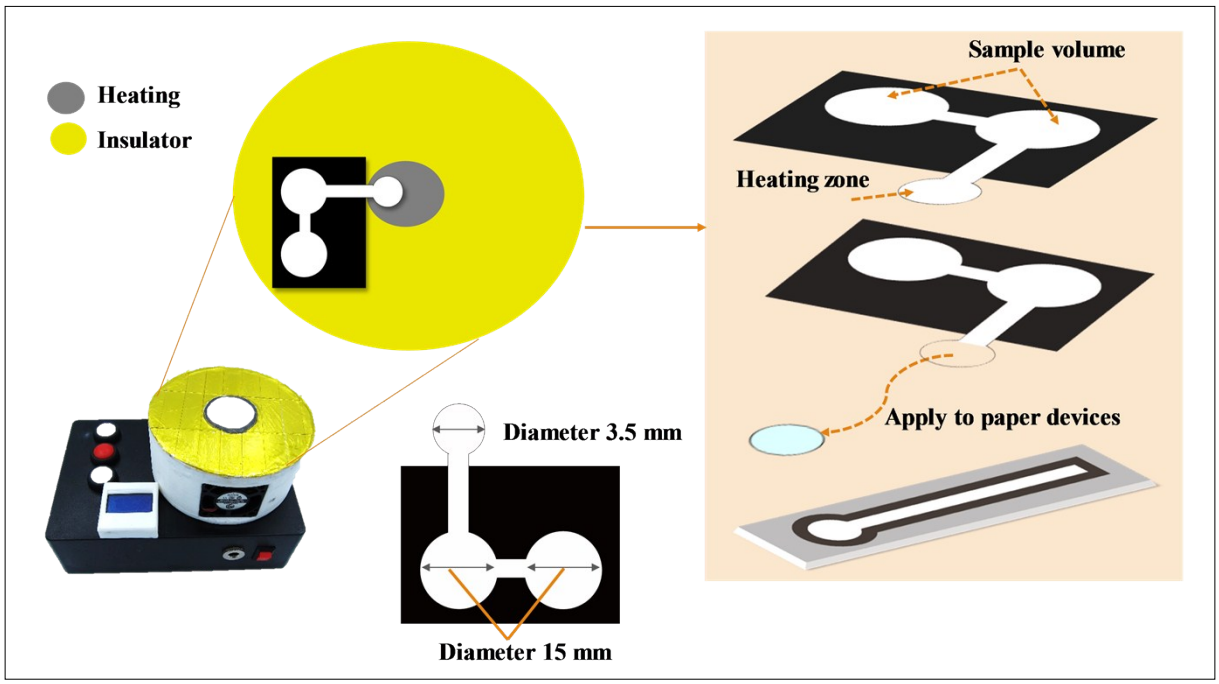
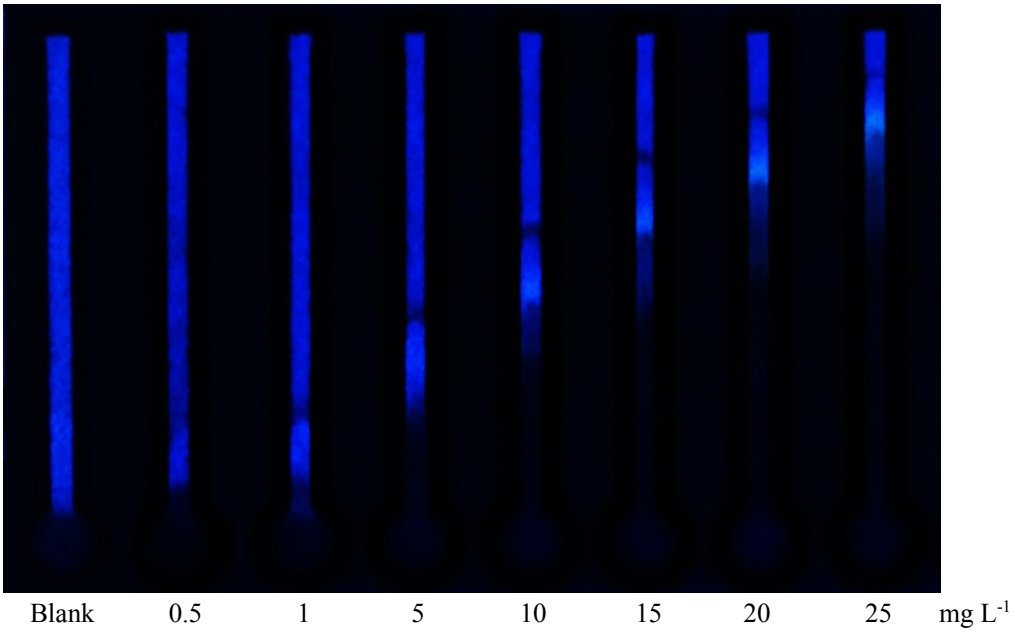


Fig. S9 Preconcentration using heating system which was controlled at 100 ºC ± 1.

(a)



(b)

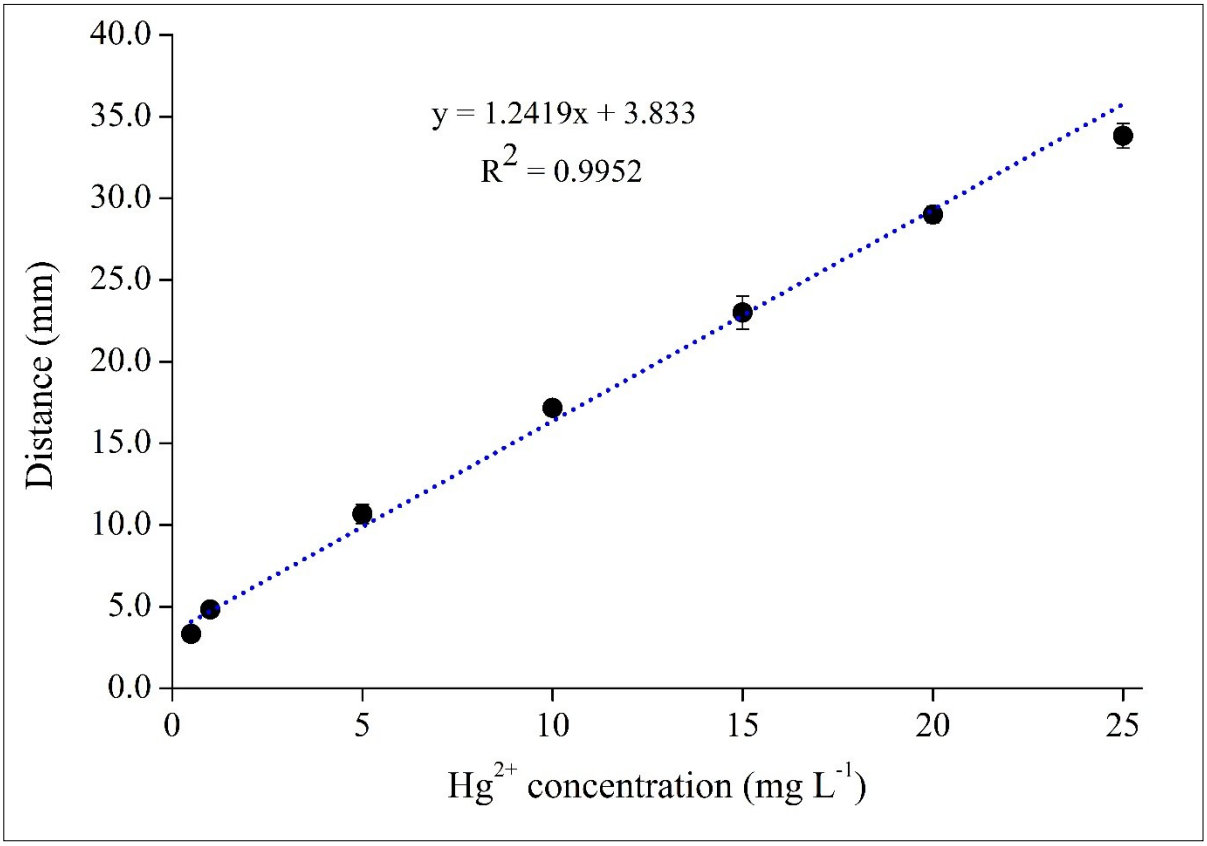
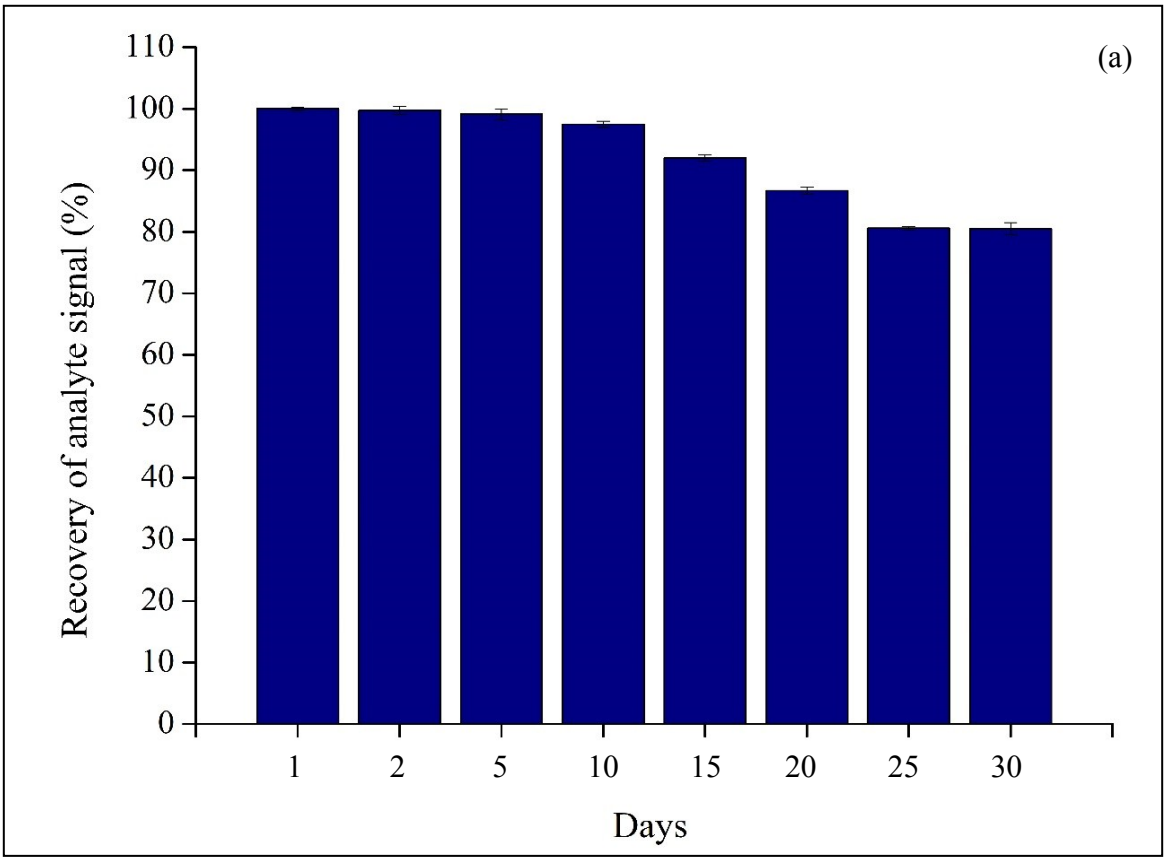


Fig. S10 The determination of Hg^{2+} using fluorescent distance-based paper device with the image under black light (a) and calibration curve in the range 0.5 – 25 mg L^{-1} (b).

10. Stability of NCDs



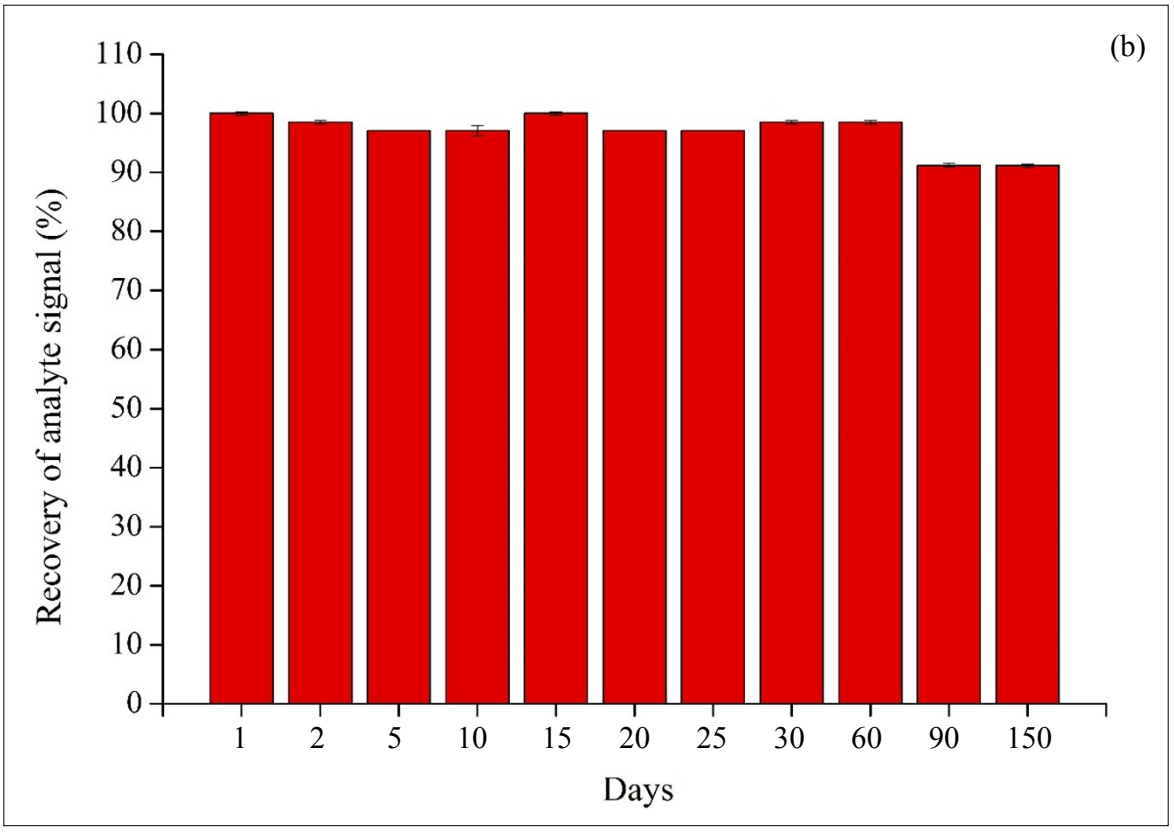


Fig. S11 Stability of CDs in solution (a) and on distance-based paper device (b).

11. Statistical testing

Table S1 Comparison between our method and HG-AAS with t-test

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	1.806667	1.743333
Variance	0.003733	0.018233
Observations	3	3
Pearson Correlation	0.977716	
Hypothesized Mean Difference	0	
df	2	
t Stat	1.436265	
P(T<=t) one-tail	0.143722	
t Critical one-tail	2.919986	
P(T<=t) two-tail	0.287444	
t Critical two-tail	4.302653	

Table S2 Lifetime of NCDs for 150 days with ANOVA

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	229.7452	10	22.97452	1.536822	0.192083	2.296696
Within Groups	328.886	22	14.94937			
Total	558.6312	32				