Electronic Supplementary Information

Use of Nitrogen-doped amorphous Carbon nanodots (N-CNDs) as fluorometric paper-based sensor: A new approach for sensitive determination of lead (II) at trace level under high ionic matrices

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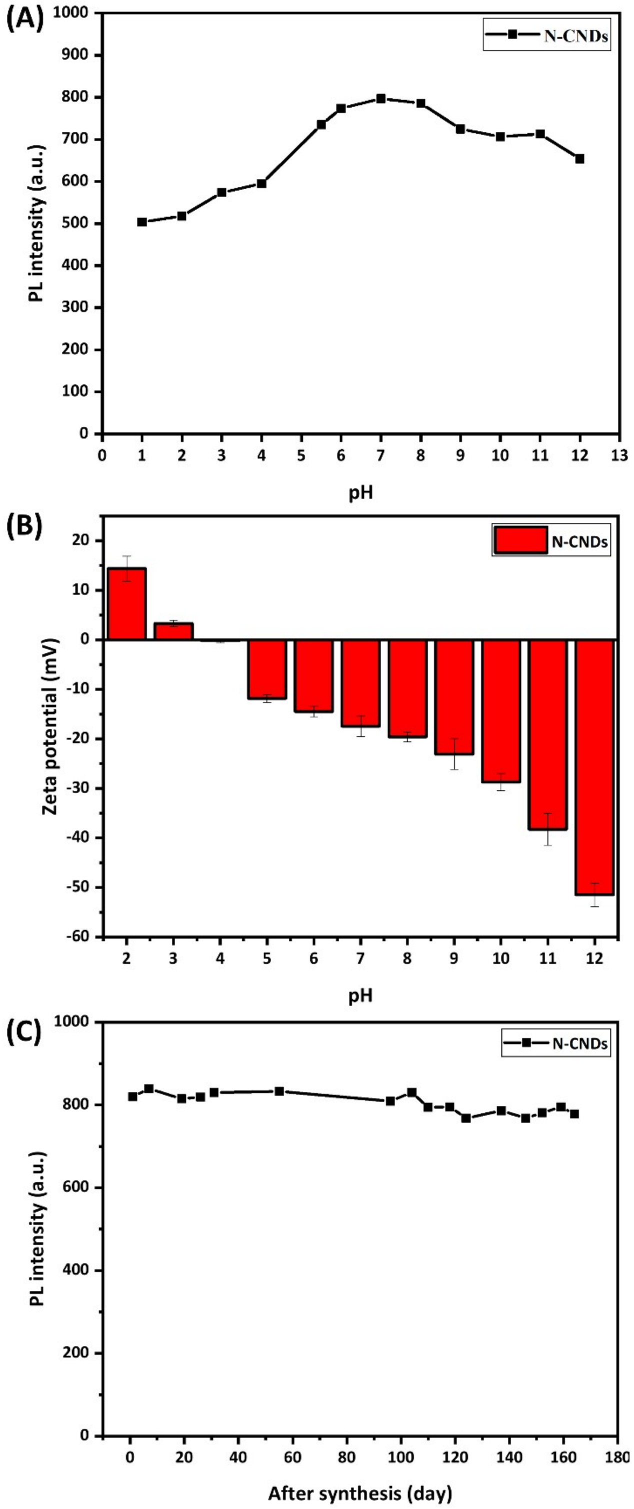

Fig. S1 (A) The effects of the pH values on the fluorescence intensity of N-CNDs; (B) Zeta potentials of N-CNDs at different pH values and (C) The storage stability.

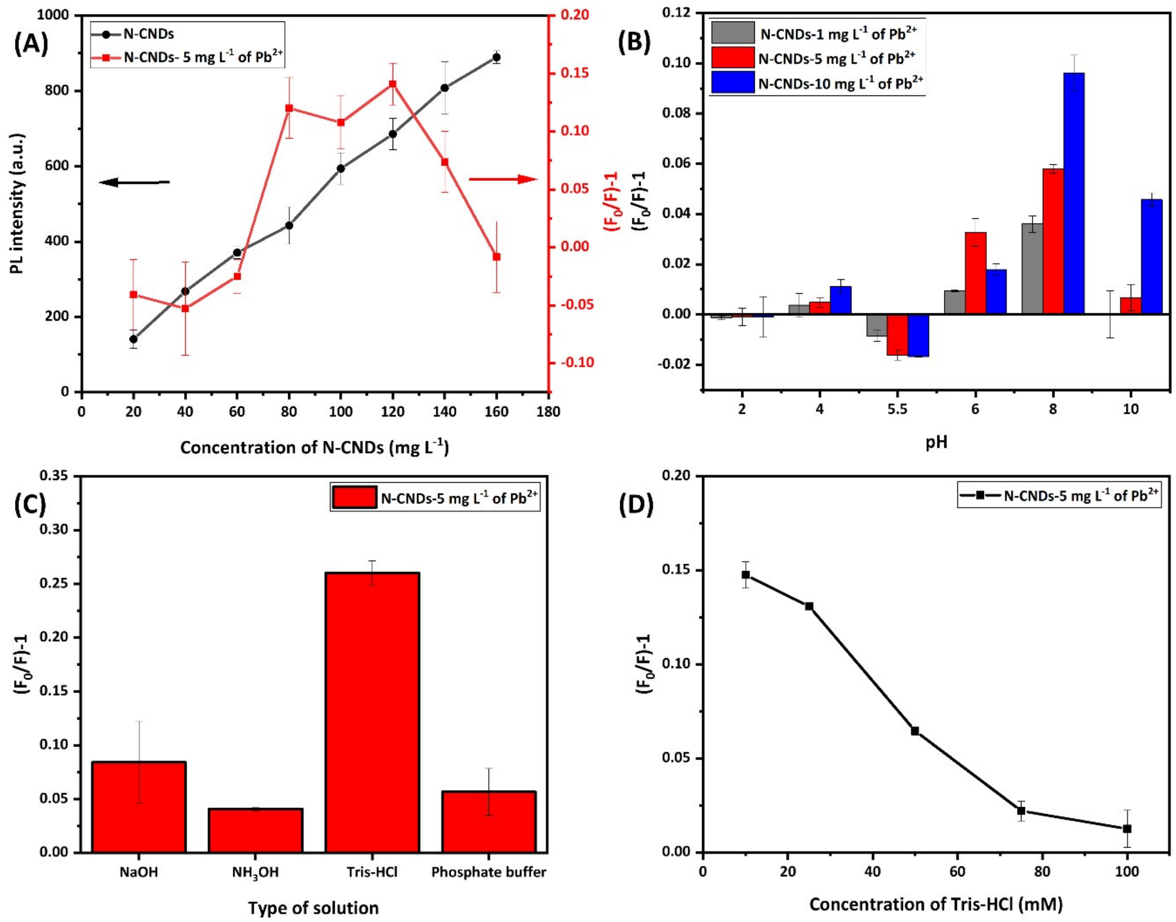

Fig. S2 (A) The effects on the fluorescence intensity of the developed Pb^{2+} sensor in the presence and the absence of 5 mg L^{-1} Pb^{2+} solution of the following factors: (A) N-CNDs concentration; (B) pH; (C) Type of solution (pH 8) and (D) Tris-HCl concentration.

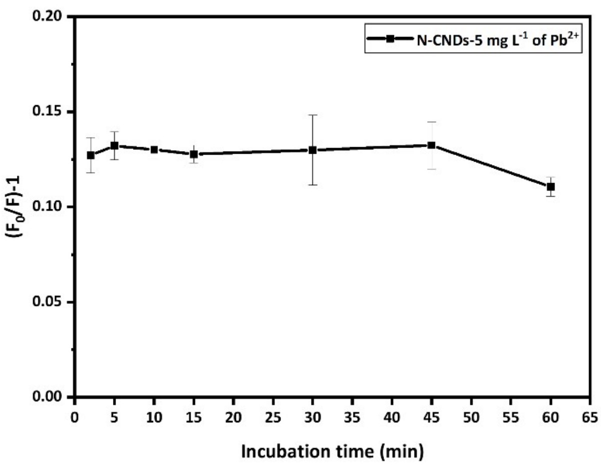

Fig. S3 The optimization effect of incubation time on the fluorescence intensity of the developed Pb^{2+} sensor.

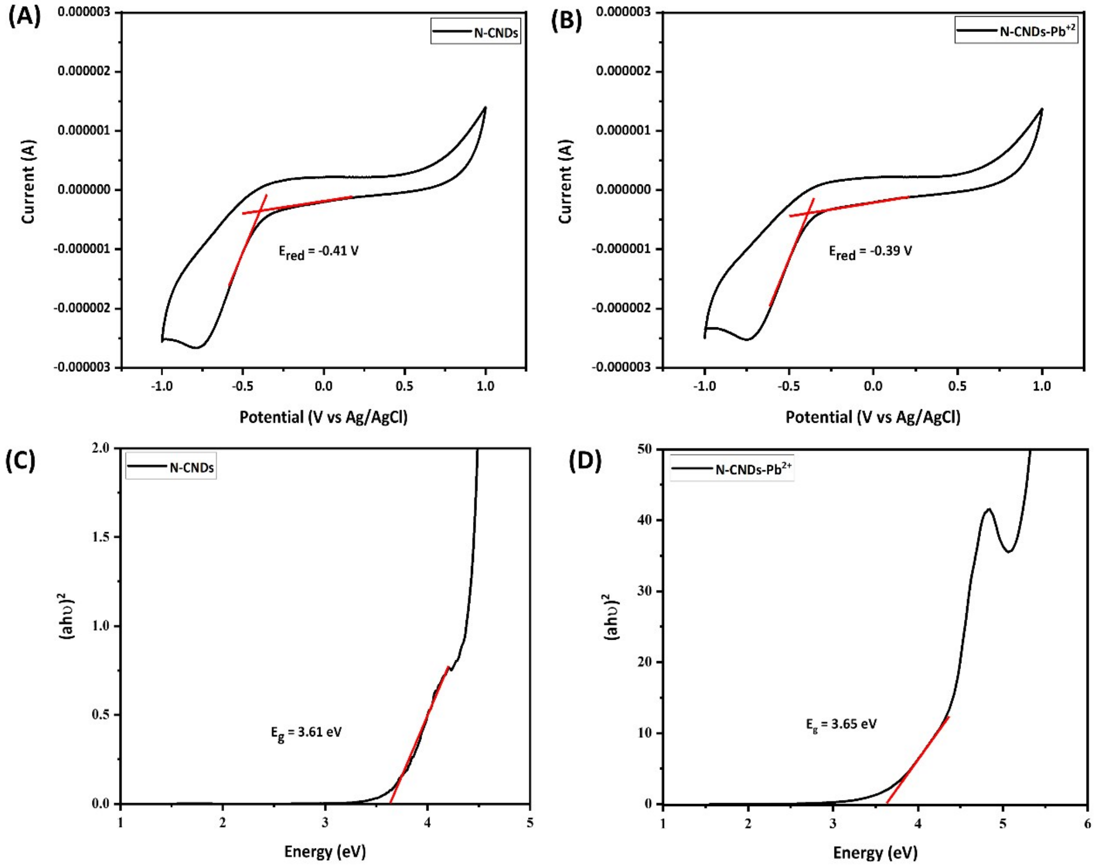

Fig. S4 Cyclic voltammograms of (A) N-CNDs and (B) N-CNDs-Pb^{2+}; the plots of direct allowed band gap energy of (C) N-CNDs and (D) N-CNDs-Pb^{2+}.

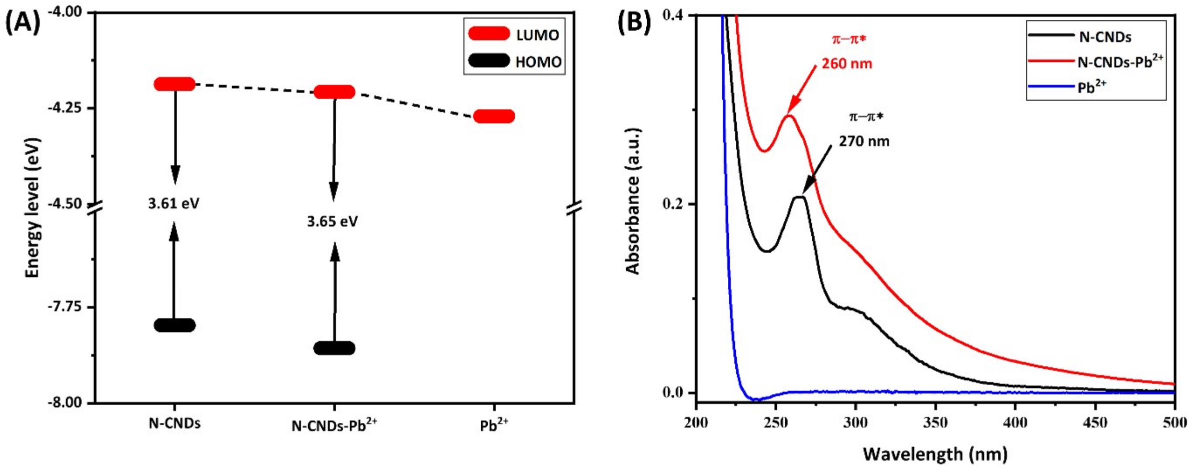

Fig. S5 (A) Proposed energy levels of N-CNDs and N-CNDs-Pb^{2+} (B) UV–Visible absorption spectra of N-CNDs, Pb^{2+}, and N-CNDs-Pb^{2+}.

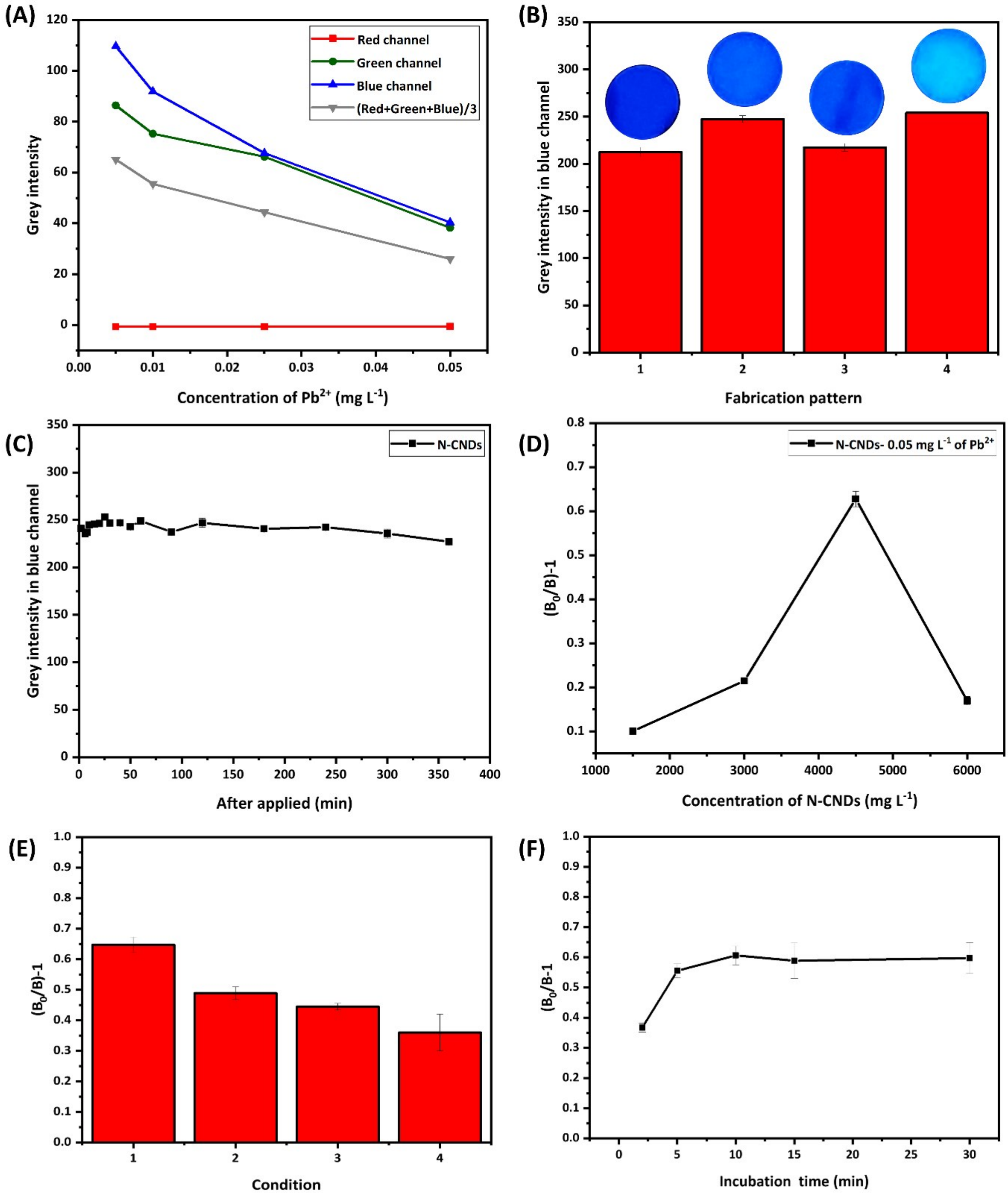

Fig. S6 (A) The plot of response in grey intensity in various channels for N-CNDs tethered paper-based sensor versus different concentrations of added Pb^{2+}. (B) The effects on the grey intensity in the blue channel for N-CNDs tethered paper-based sensor of the following fabrication techniques: i) one layer of filter paper; ii) double layers of filter paper; iii) one layer attached with the double-sided adhesive tape and iv) two pieces of filter paper attached with the double-sided adhesive tape. (C) The stability testing on paper-based sensor. (D) The effect of N-CNDs concentration (E) The effect on the quenching efficiency of the following reagent mixing orders: i) 4500 mg L^{-1} N-CNDs pH 8 + CAPS + Pb^{2+}; ii) 4500 mg L^{-1} N-CNDs pH 8 + Pb^{2+}; iii) CAPS-6000 mg L^{-1} N-CNDs + Pb^{2+} and iv). 6000 mg L^{-1} N-CNDs + CAPS-Pb^{2+}. (F) The effect of incubation time on the quenching efficiency.

Table S1 Comparison of the performance of reported use of carbon-based dots (CDs) as a sensor for Pb^{2+} determination.

Type of CDs	Mechanism (Type)	Real samples	Range (LOD) Solution-based (mg L^{-1})	Range (LOD) Fiber-based (mg L^{-1})	Tolerance ratio		References
CNDs	Turn-off (PET)	Water	6.8×10^{-3} – 0.346 (2.6×10^{-3})	-	Monovalent Divalent Trivalent	0.6-2.6 0.6-4.8 0.7-2.6	[1]
Unclassified CDs	Turn-off (PET)	Water	4.0×10^{-4} -0.144 (2.0×10^{-6})	5.0×10^{-5} -0.207 (2.2×10^{-5})	Monovalent Divalent Trivalent	- 0.3-1.0 0.5	[2]
CNDs	Turn-off (IFE)	Water	3.5×10^{-3} – 0.207 (1×10^{-3}) 0.139-5.532 (1.1×10^{-2})	-	Monovalent Divalent Trivalent	1.7-7.8 1.8-14.5 1.9-7.8	[3]
CNDs	Turn-off	Water, cancer cell	2.1×10^{-3} – 0.2 (0.1×10^{-3})	-	Monovalent Divalent Trivalent	0.1-0.2 0.1-1.0 0.1	[4]
N-CNDs	Turn-off (Dynamic)	Water, urine, serum	0-41.4 x 10^{-3} (2.0×10^{-3})	-	Monovalent Divalent Trivalent	10 10 10	[5]
Unclassified CDs	Turn-off (IFE)	Water	0.6427×10^{-3}-3.428×10^{-3} (1.3×10^{-3})	0-41.1 x 10^{-3} (0.6×10^{-3})	Monovalent Divalent Trivalent	1.1 1.2-9.7 1.3-2.7	[6]
CNDs	Turn-off (Static)	-	2.1×10^{-4}- 0.2 (7.68×10^{-3})	-		-	[7]
N-CNDs	**Turn-off (PET)**	**Water (various types), herbs**	**0.010-10 (0.008)**	**0.005-0.075 (0.004)**	**Monovalent** **Divalent** **Trivalent**	**2[a], 50[b]** **1-10[a], 5-100[b]** **1-2[a], 5-100[b]**	**This work**

[a]Solution-based system [b]Fiber-based system

Table S2 Intra- and inter-batch precision of the proposed systems

Concentration of lead (mg L^{-1})	Intra-batch (n=3)	Inter-batch (n=3)
	%RSD	%RSD
Solution-based system		
0.50	1.79	9.68
10.00	3.94	8.27
Paper-based system		
0.025	5.32	7.49
0.075	1.51	9.75

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