

Supplementary Material

Fluorescent Biosensor Based Cerium-Doped Carbon Quantum Dots for Albumin Detection

Nashwa Ashraf Hafez, Eman Fadl, Shaker Ebrahim, Moataz Soliman, Azza Shokry*

Department of Materials Science, Institute of Graduate Studies and Research, Alexandria University, P.O. Box 832, Alexandria, Egypt.

* **Correspondence to:** Institute of Graduate Studies and Research, Alexandria University, PO Box 832, 163 Horreya Avenue, El-Shatby, Alexandria, Egypt. Azza Shokry azzashokry@alexu.edu.eg

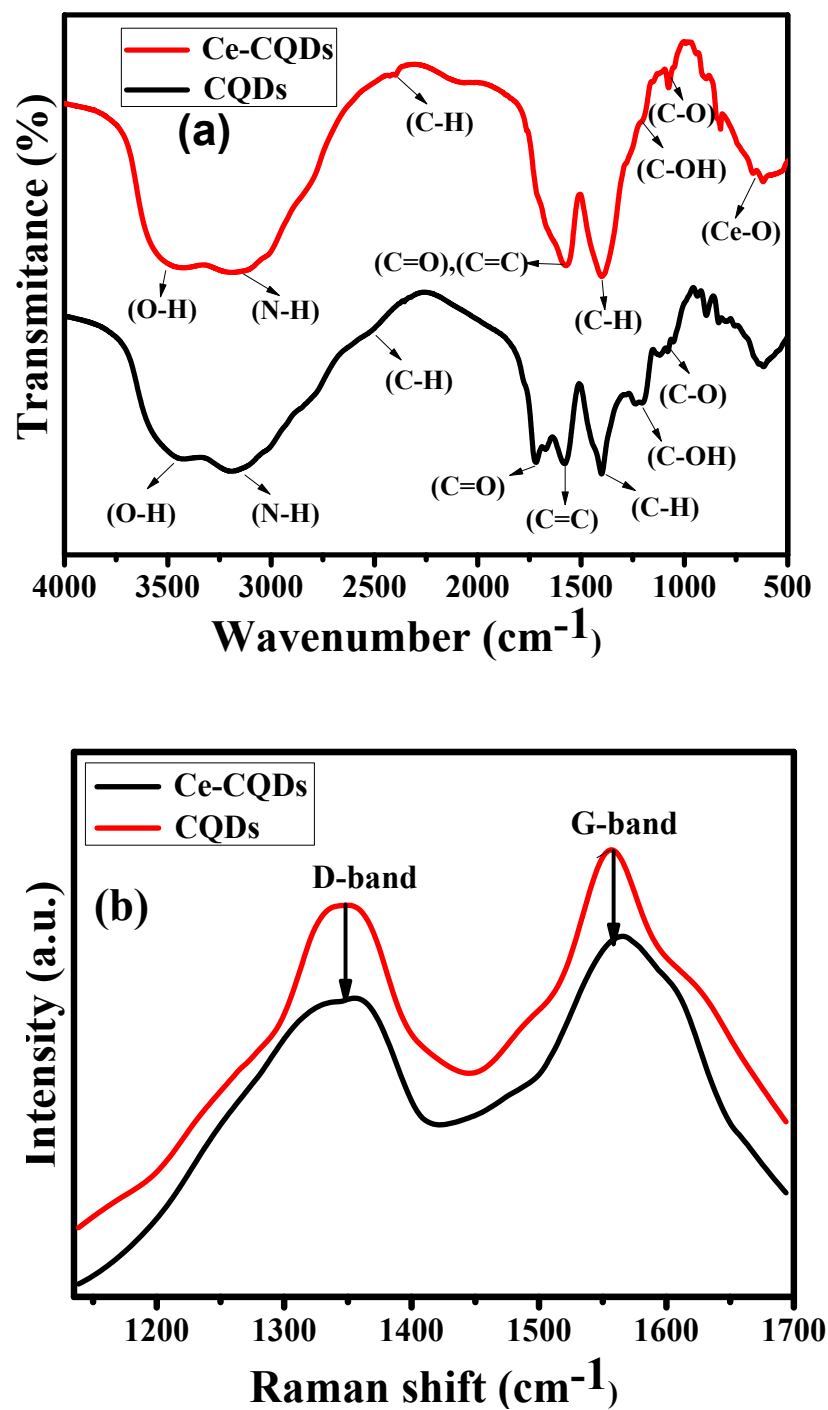
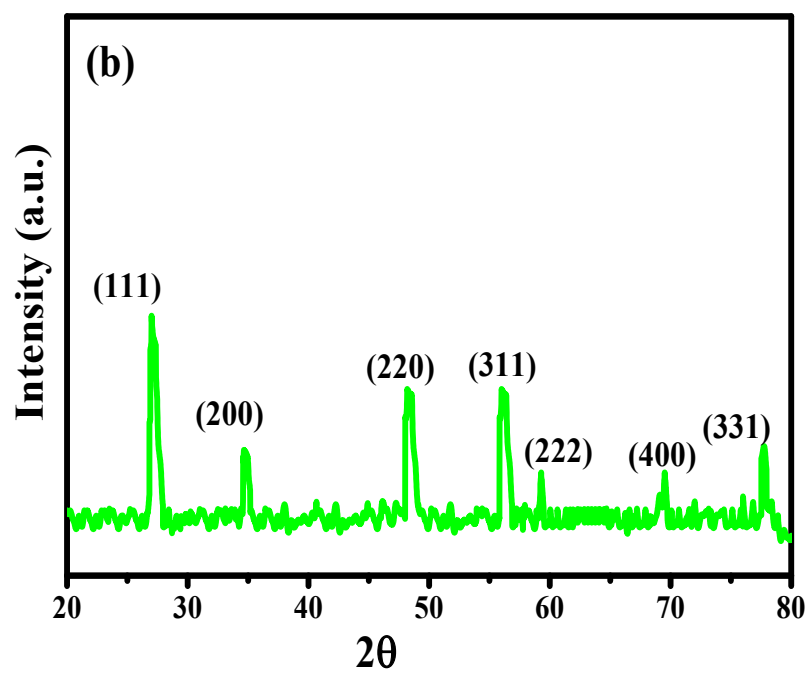
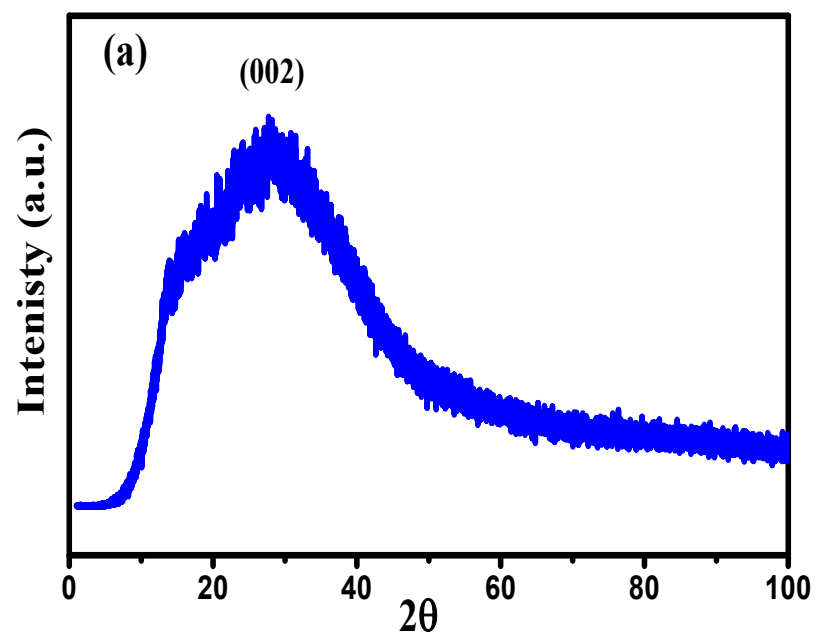


Fig. S1. FTIR spectra (a) and Raman spectra (b) of CQDs and Ce-CQDs. Reproduced from: Hafez, A. N., Fadl, E., Ebrahim, S., Soliman, M., and Shokry, A., (2025). Fluorescent cerium doped carbon quantum dots for detection of ferric ions. *Ceramics International*, 51, 34350-34364. Copyright (2025), with permission from Elsevier Ltd and Techna Group S.r.l.



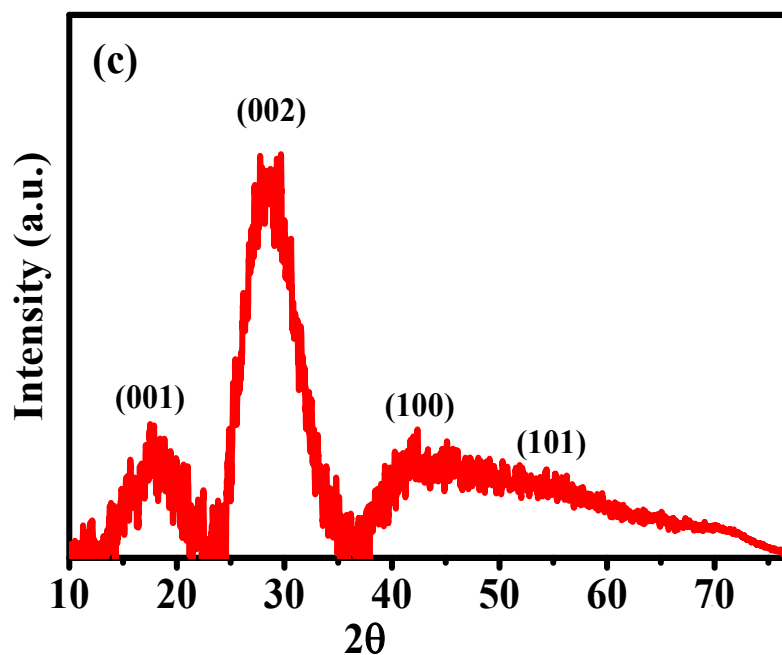


Fig. S2. XRD patterns of CQDs (a), CeO₂ (b), and Ce-CQDs (c). Reproduced from: Hafez, A. N., Fadl, E., Ebrahim, S., Soliman, M., and Shokry, A., (2025). Fluorescent cerium doped carbon quantum dots for detection of ferric ions. *Ceramics International*, 51, 34350-34364. Copyright (2025), with permission from Elsevier Ltd and Techna Group S.r.l.

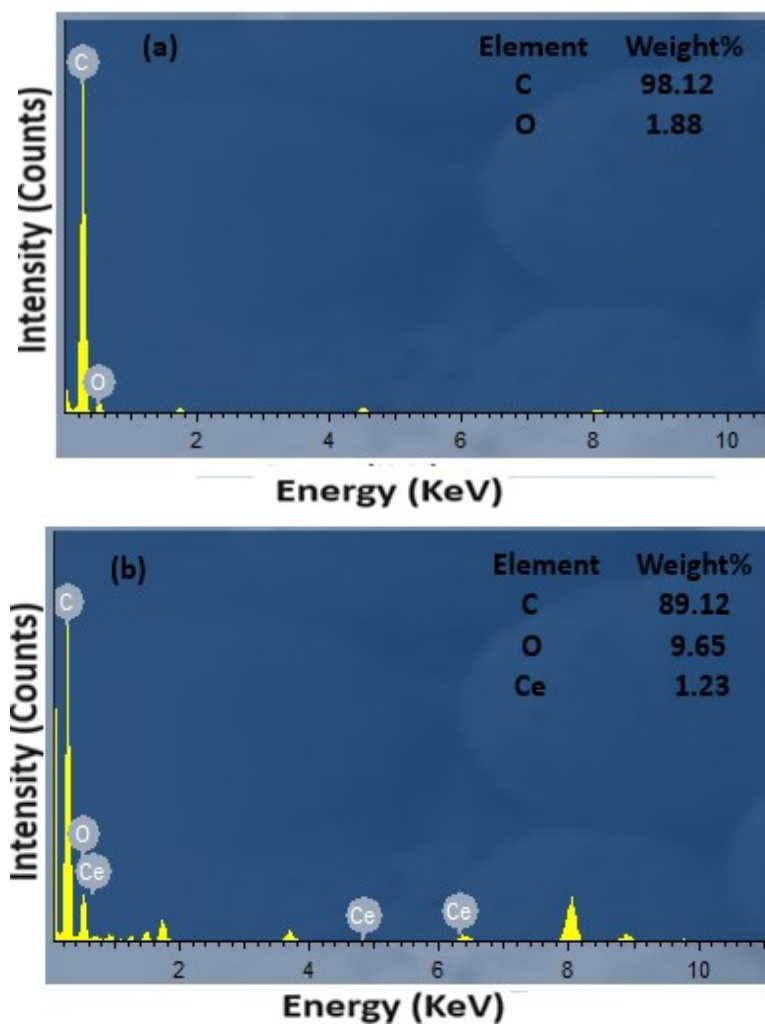


Fig. S3.

EDX spectra of CQDs (a) and Ce-CQDs (b). Reproduced from: Hafez, A. N., Fadl, E., Ebrahim, S., Soliman, M., and Shokry, A., (2025). Fluorescent cerium doped carbon quantum dots for detection of ferric ions. *Ceramics International*, 51, 34350-34364. Copyright (2025), with permission from Elsevier Ltd and Techna Group S.r.l.

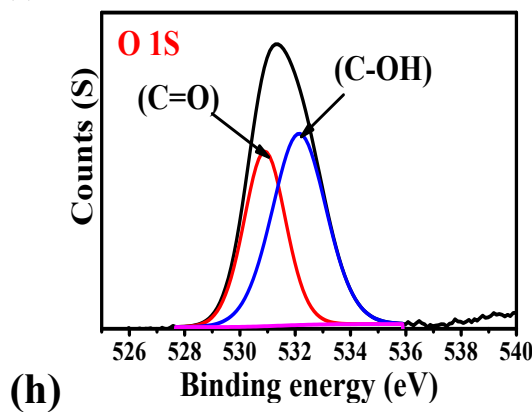
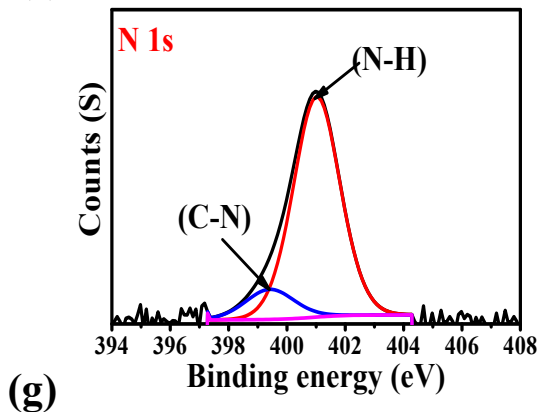
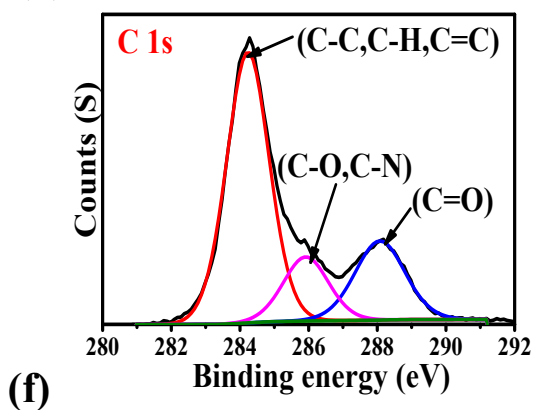
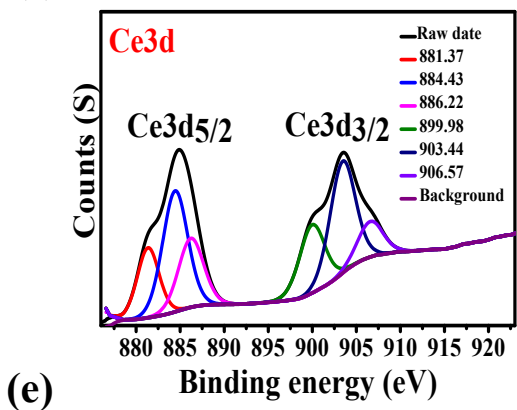
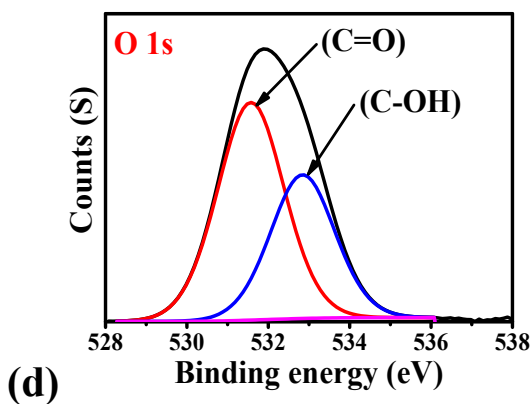
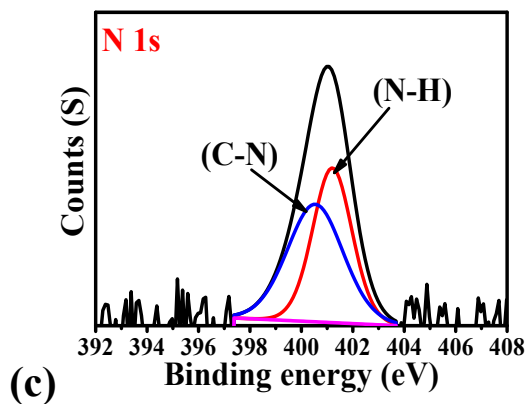
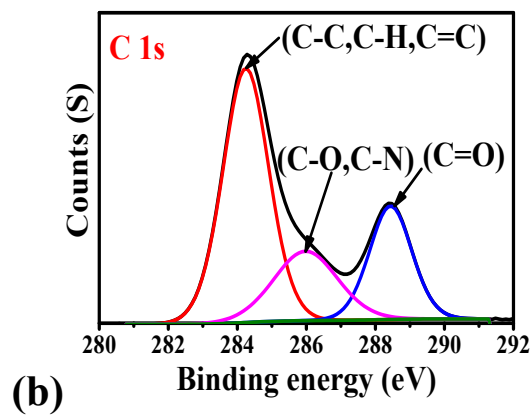
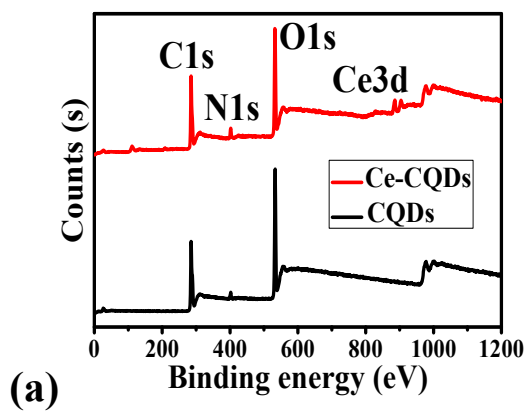


Fig. S4. XPS full-range images showing CQDs and Ce-CQDs (a), C 1s of CQDs (b), N 1s of CQDs (c), O 1s of CQDs (d), Ce 1s of Ce-CQDs (e), C 1s of Ce-CQDs (f), N 1s of Ce-CQDs (g), and O 1s of Ce-CQDs (h). Reproduced from: Hafez, A. N., Fadl, E., Ebrahim, S., Soliman, M., and Shokry, A., (2025). Fluorescent cerium doped carbon quantum dots for detection of ferric ions. *Ceramics International*, 51, 34350-34364. Copyright (2025), with permission from Elsevier Ltd and Techna Group S.r.l.

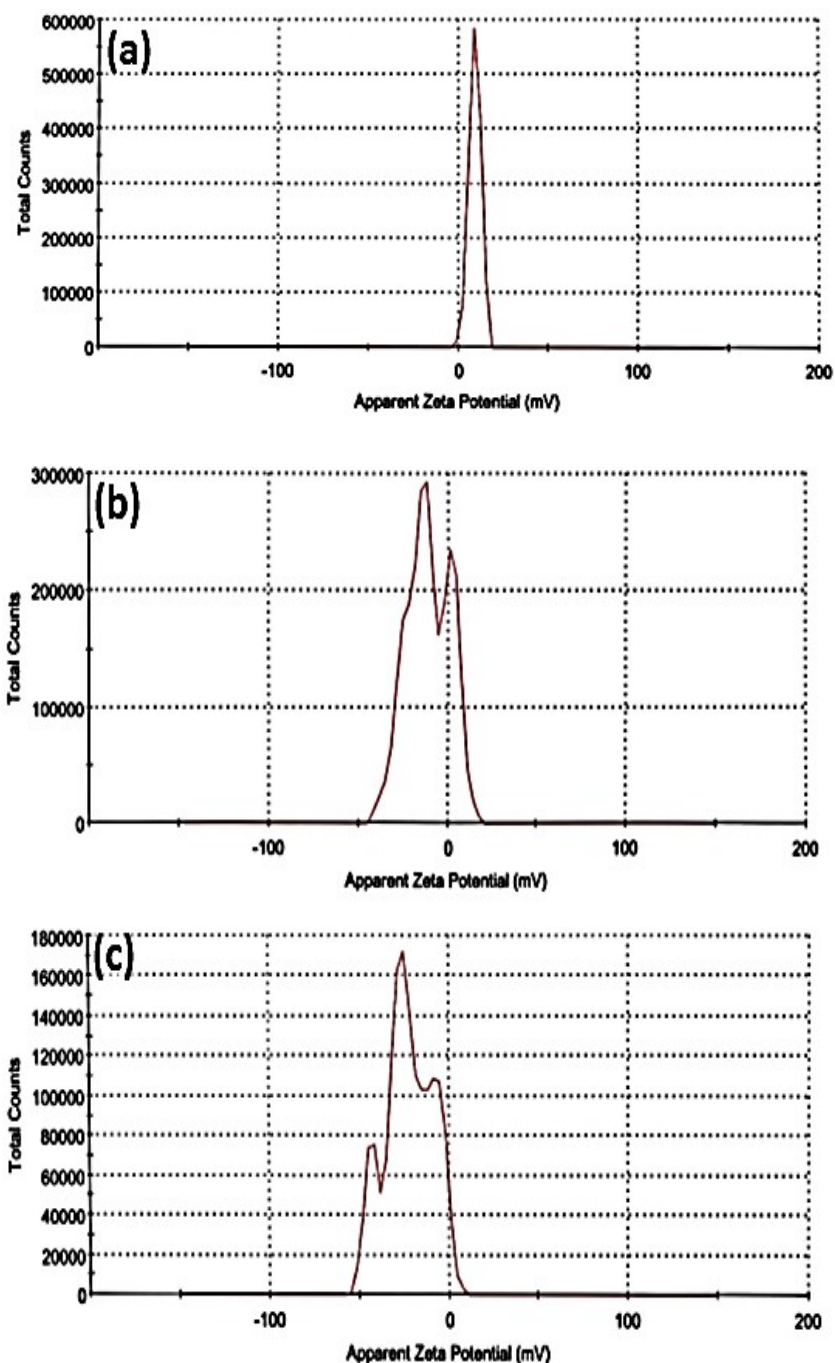


Fig. S5. Zeta potential charts of Ce (a), CQDs (b), and Ce-CQDs (c). Reproduced from: Hafez, A. N., Fadl, E., Ebrahim, S., Soliman, M., and Shokry, A., (2025). Fluorescent cerium doped carbon quantum dots for detection of ferric ions. *Ceramics International*, 51, 34350-34364. Copyright (2025), with permission from Elsevier Ltd and Techna Group S.r.l.

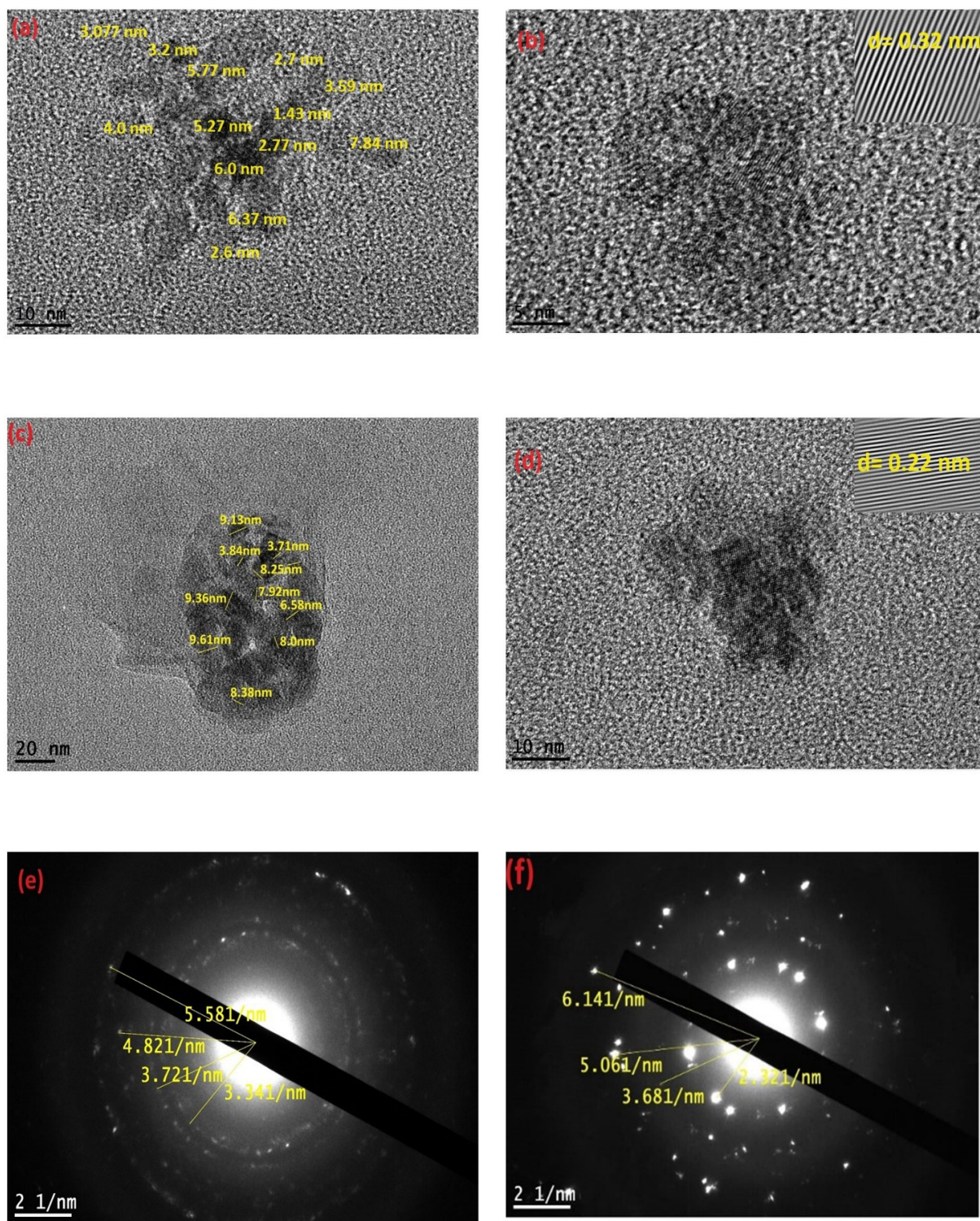


Fig. S6. HRTEM images of CQDs with different magnifications (a, b). The inset in (b) is d spacing of CQDs, HRTEM images of Ce-CQDs at different magnifications(c,d). The inset in (d) is the d spacing of Ce-CQDs (d). Electron diffraction patterns of CQDs (e) and Ce-CQDs (f). Reproduced from: Hafez, A. N., Fadl, E., Ebrahim, S., Soliman, M., and Shokry, A., (2025). Fluorescent cerium doped carbon quantum dots for

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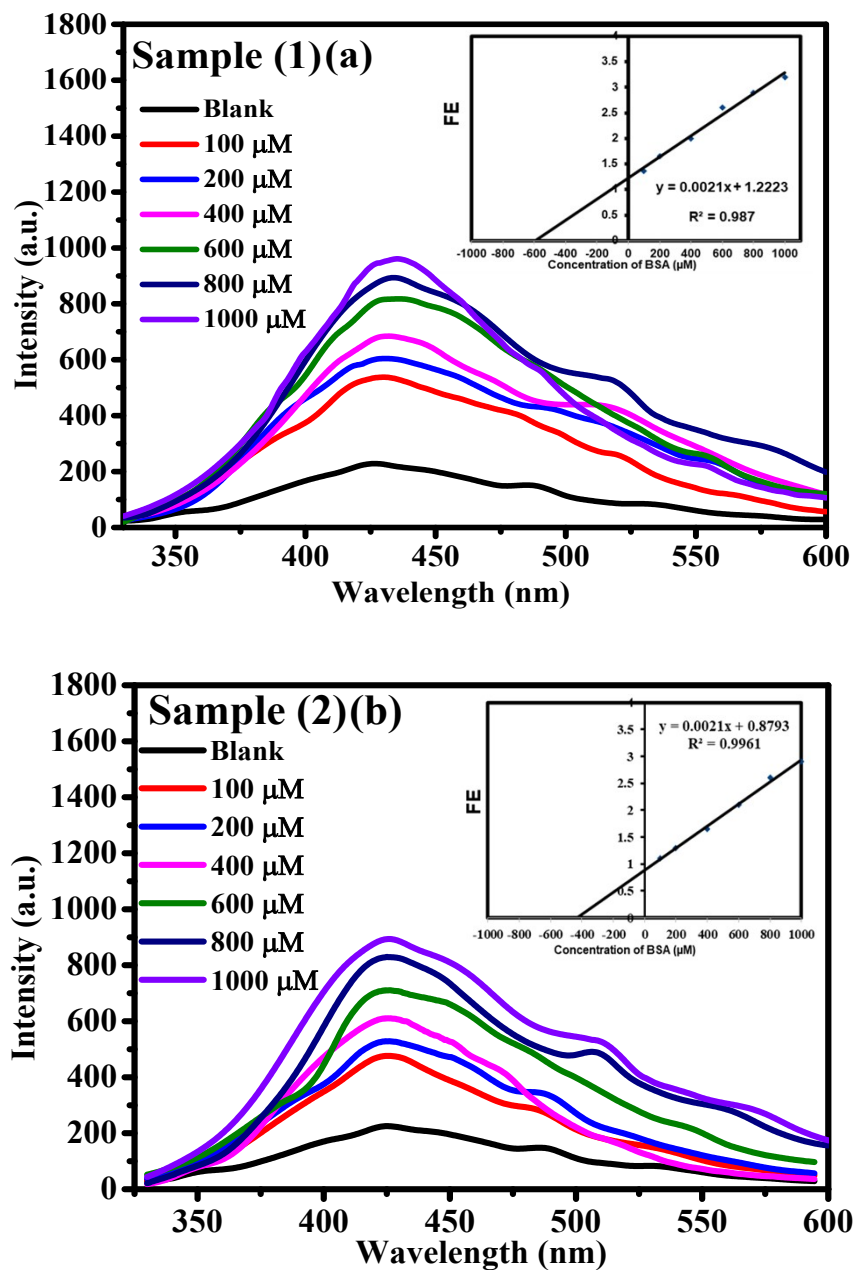


Fig. S7. PL spectra of Ce-CQDs in two serum samples (a and b) of 0.1 M PBS at pH 7.3 ± 0.1 and $\lambda_{\text{ex}} = 310$ nm. The insets in Fig. 10 (a) and (b) are FE vs. BSA concentrations from 100 to 1000 μM . Reproduced from: Hafez, A. N., Fadl, E., Ebrahim, S., Soliman, M., and Shokry, A., (2025). Fluorescent cerium doped carbon quantum dots for detection of ferric ions. *Ceramics International*, 51, 34350-34364. Copyright (2025), with permission from Elsevier Ltd and Techna Group S.r.l.

Table S1. Analytical performance and recovery of BSA in real serum samples

Added BSA (μM)	Given clinical data (μM)	Ce-CQDs Sensor		
		Found	Recovery (%)	RSD (% , n = 3)
600	586	590	98.3	0.267
400	396	410	102.5	0.251

The recovery percentage is calculated as $(\text{Found} / \text{Added}) \times 100\%$.

Table S2. The analysis results of BSA levels in urine samples.

Added BSA (μM)	Given clinical data (μM)	Ce-CQDs Sensor		
		Found	Recovery (%)	RSD (% , n = 3)
4.5	4.5	4.6	102.8	0.207
15	15	15.9	106	0.142
45	45	42.2	93.7	0.133

The recovery percentage is calculated as $(\text{Found} / \text{Added}) \times 100\%$.