Electronic Supplementary Materials (ESM)

Enhanced Fluorescent Detection of Oxaliplatin via BSA@Copper Nanoclusters: A Targeted Approach for Cancer Drug Monitoring

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Instrumentation and calculation of quantum yield

Fluorescence emission spectrum measurements were conducted using a Shimadzu RF-5301PC fluorescence spectrometer (Tokyo, Japan). The instrument utilized a 1 cm quartz cell and employed a 5 nm slit width. UV-Vis measurements were performed using a Shimadzu UV-1601 spectrophotometer (Tokyo, Japan). Transmission electron microscopy (TEM) images were captured using a JEOL JEM-1400 microscope operating at 200 kV (Japan). FT-IR spectral studies were carried out using a Nicolet 6700 FT-IR series spectrophotometer with KBr pellets as the source material, covering a spectral range from 4000 cm^{-1} to 400 cm^{-1}. X-ray diffraction patterns were obtained using a Philips PW 1700 X-Ray diffractometer (Eindhoven, Netherlands). X-ray photoelectron spectroscopy (XPS) data were acquired using an ESCALAB 250 XI instrument (Thermo Scientific) equipped with Al Kα X-ray radiation as the excitation source. Particle size measurements were conducted using a Zetasizer nano analyzer. Dynamic light scattering (DLS) measurements were conducted using the Zetasizer Red Badge instrument of the ZEN 3600 Nano ZS model from Malvern, UK. Elemental analysis (EDX) for demonstrating the elemental composition of BSA@CuNCs was carried out with the NEX QC+ QuantEZ.

The quantum yield (Ø) of BSA@CuNCs was calculated using quinine sulfate (0.1 M H_2SO_4 as solvent) as a standard reference, i.e., at the excitation wavelength of 350 nm, its QY was 56% in 0.1 M H_2SO_4 solution. The fluorescent spectra of quinine sulfate and BSA@CuNCs were measured at excitation wavelengths of 350 nm and the absorbance was kept under 0.05. The quantum yield was calculated according to the following Equation:

$$\phi = \phi_{quinine} \times \frac{F_{BSA@CuNCs}}{F_{quinine}} \times \frac{A_{quinine}}{A_{BSA@CuNCs}} \times \frac{\eta_{BSA@CuNCs}}{\eta_{quinine}}$$

Ø denotes the QY of BSA@CuNCs; F and A are the integral area of fluorescence emission peak and UV–Vis absorbance intensity at excitation wavelength, respectively; η is the refractive index of the solvent.

Fig.S1A presents the XPS spectrum of the as-prepared BSA@CuNCs, revealing distinct peaks corresponding to C 1s, O 1s, N 1s, S 2p, and Cu 2p. In **Fig.S1B**, the HRXPS analysis of S 2p exhibits two sharp peaks at 161.3 eV and 162.6 eV, indicating sulfur binding with CuNCs [1, 2]. **Fig.S1C** illustrates the HRXPS of BSA@CuNCs, showing two prominent peaks at 931.8 eV and 953.5 eV, attributed to Cu 2p3/2 and Cu 2p1/2, respectively, confirming the presence of Cu°. Furthermore, the absence of a satellite peak at 943.4 eV confirms the absence of cupric ions (Cu^{2+}) in BSA@CuNCs.
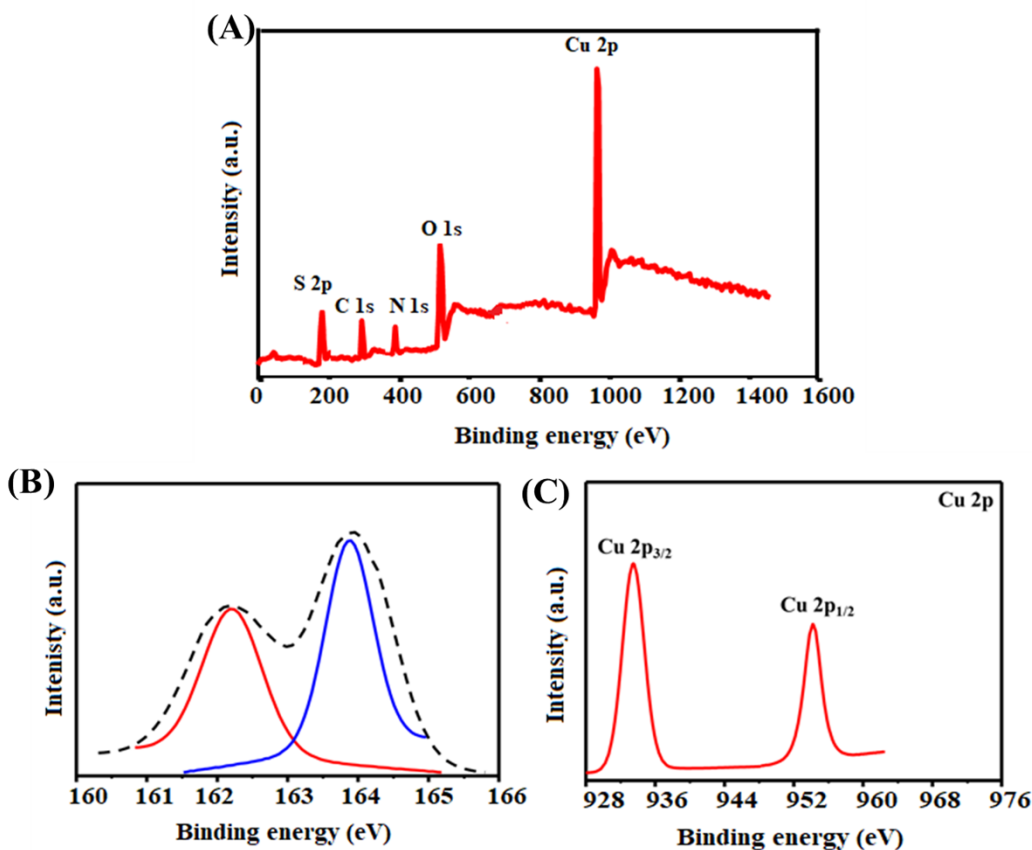

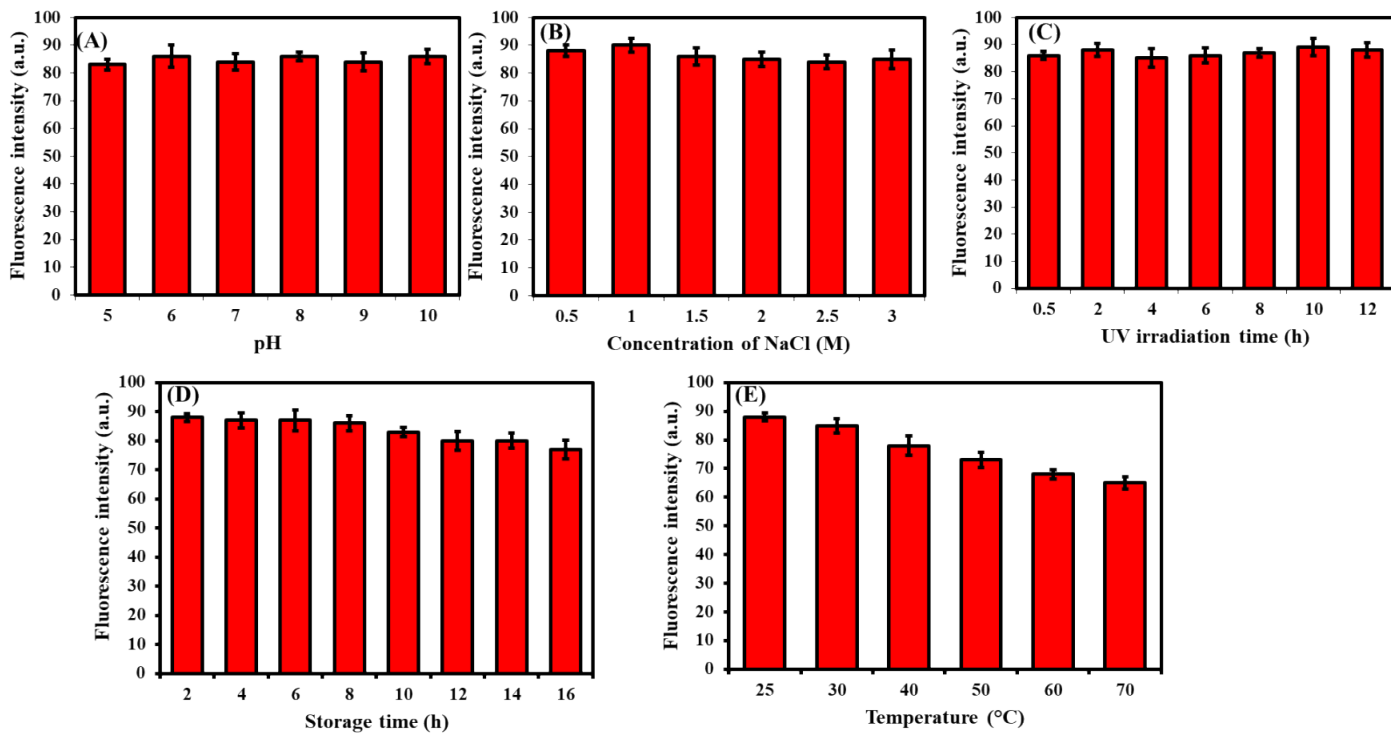**Fig.S1** (A) XPS of BSA@CuNCs; (B) HRXPS of S 2p; (C) HRXPS of Cu 2p.

Fig.S2 The influence of pH (A), concentration of NaCl (B), UV irradiation time (C), storage time (D), and temperature (E) on the fluorescence emission of BSA@CuNCs.
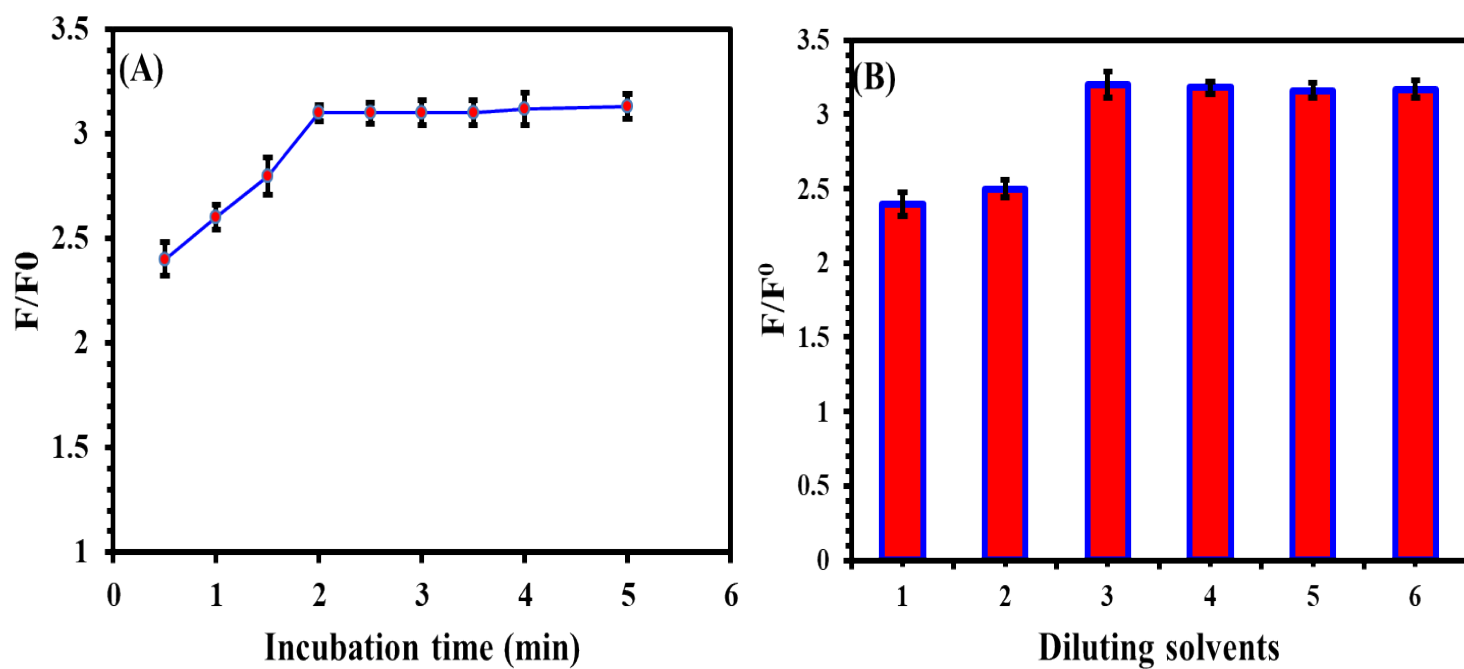
Fig.S3 (A) The influence of reaction time on the fluorescence emission of BSA@CuNCs in the presence of 30 µM Oxal-Pt. (B) Effect of diluting solvent on the fluorescence emission of BSA@CuNCs in the presence of 30 µM Oxal-Pt using different diluting solvents: (1) 0.1 M HCl, (2) 0.1 M NaOH, (3) 0.1 M citrate buffer saline, (4) 0.1 M acetate buffer saline, (5) 0.1 M phosphate buffer saline, and (6) H_2O.
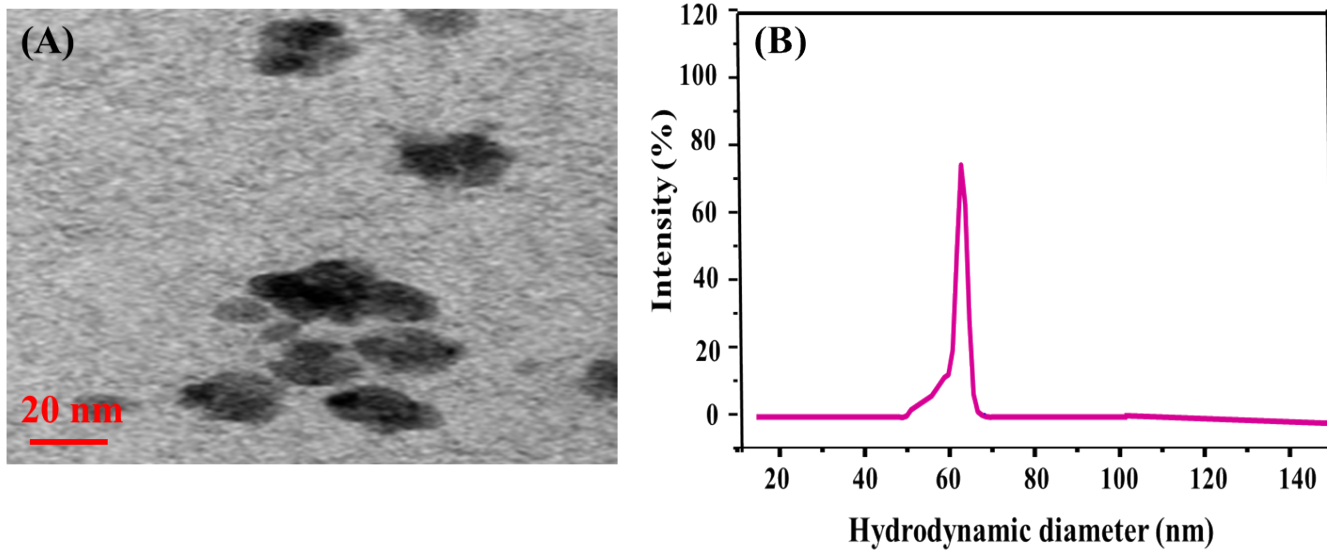
Fig.S4 TEM image (A) and DLS (B) of BSA@CuNCs after addition of Oxal-Pt.

References

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