Electronic Supplementary Materials

Facile fabrication of boron and nitrogen co-doped carbon dots for "ON-OFF-ON" fluorescence sensing of Al^{3+} and F^- ions in water samples

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Instrumentation

Excitation and emission spectra were measured on SCINCO FluoroMate (FS-2, Korea) spectrofluorometer with slit width of 3 nm and 1 cm quartz cuvette. Transmission Electron Microscope (TEM) was used to investigate the morphology of BN@CDs (JEOL JEM-100CX II-unit). FT-IR measurements were carried out on Nicolet™ iS™10 spectrometer. Elemental analysis (EDX) was used to show the elemental composition of BN@CDs using NEX QC+ QuantEZ. The X-ray diffraction spectrometer (XRD) PW 1710 was used to investigate the peak diffraction. Raman spectra were taken on Micro-Raman spectrometer (U.K.). Dynamic light scattering measurements (DLS) were carried out using Zetasizer Red badge instrument of ZEN 3600 Nano ZS model (Malvern, UK). X-ray photoelectron spectrometer (XPS, ESCA Ulvac-PHI 1600, PHI Quantum 2000 XPS system, Physical Electronics, USA) was used to reveal the surface functional groups of BN@CDs.

Quantum yield (QY) measurement

The QY of the fluorescent BN@CDs was determined by a relative slope method. Quinine sulfate (QY=54% in 0.1 M H_2SO_4) was selected as a standard for the prepared BN@CDs. The aqueous solution of BN@CDs and quinine sulfate ware diluted to keep the absorption intensity below 0.1 at the best excitation wavelength of 360. The QY of the prepared BN@CDs was calculated according to the following equation (1).

$$\varphi_x = \varphi_{st} (K_x/K_{st}) (\eta_x/\eta_{st})^2 \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where φ is the quantum yield, K is the slope of the fitted line, and η is the refractive index of the solvent. The subscript “x” refers to the testing sample, and “st” refers to the standards. The value of the refractive index is 1.33 for water.

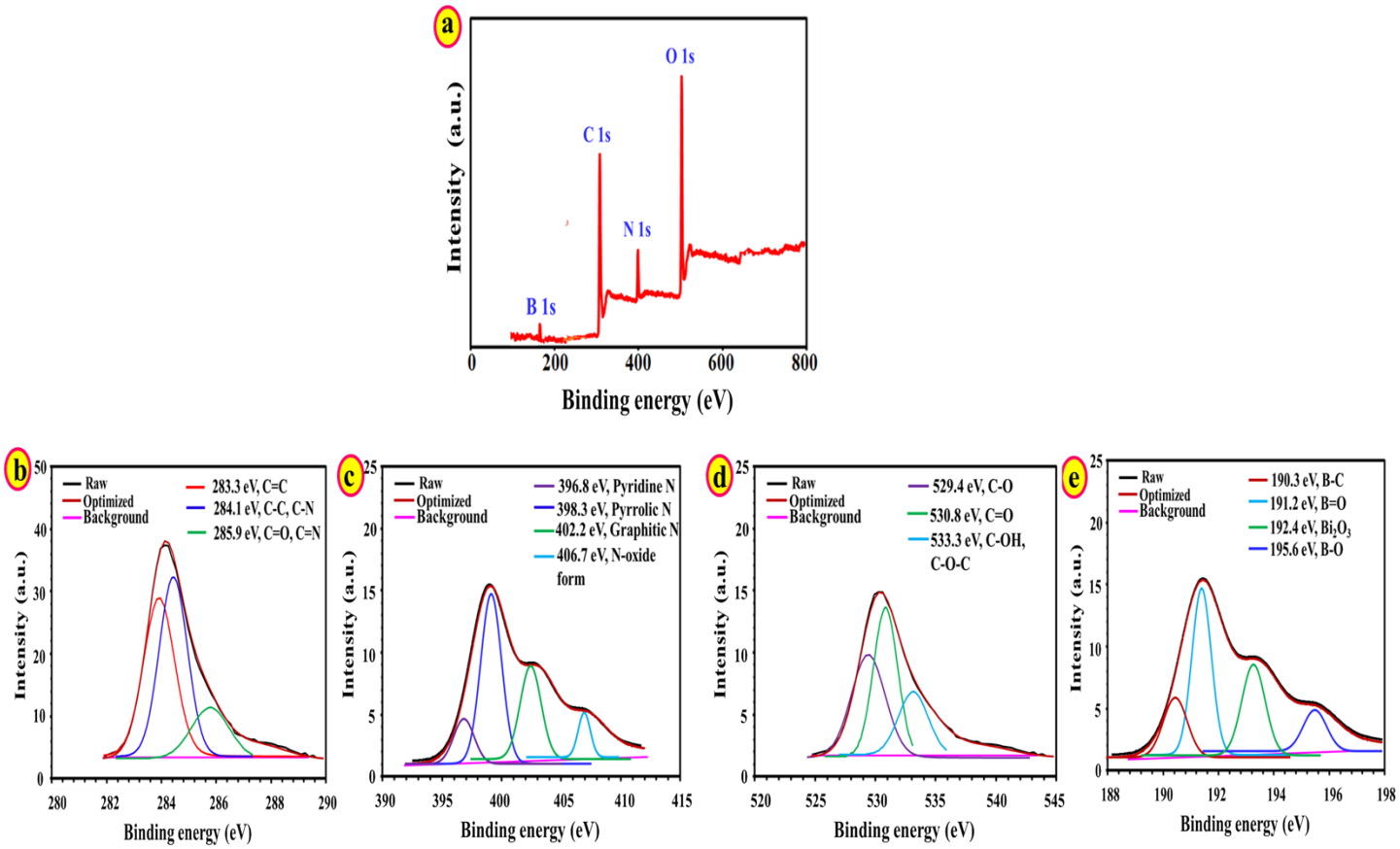

Fig.S1 (a) XPS spectrum of BN@CDs while (b), (c), (d), and (e) are HR-XPS of C 1s, N 1s, O 1s, and B 1s, respectively.

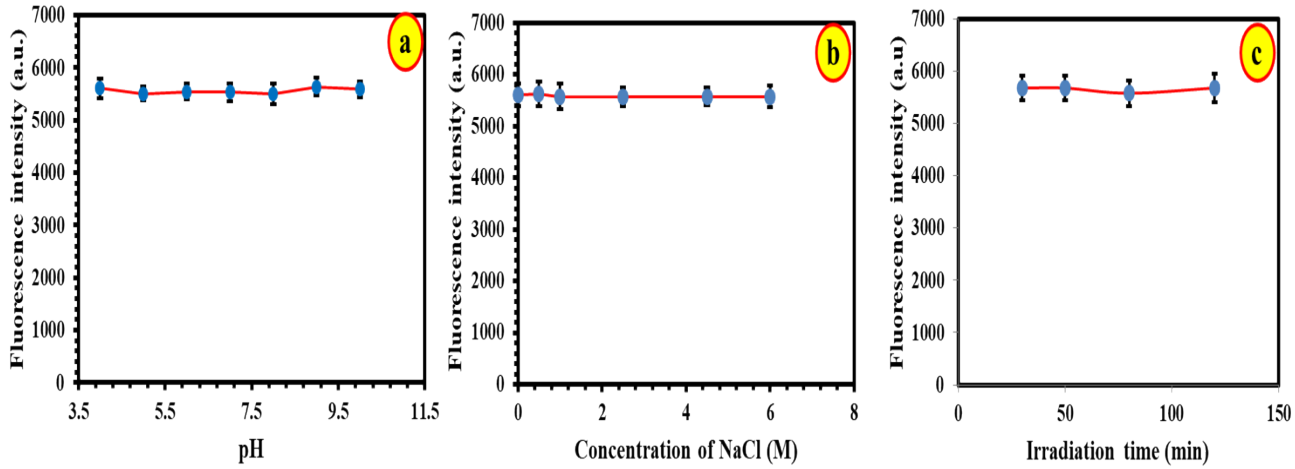

Fig.S2 The influence of (a) different pH values, (b) ionic-strength, and (c) irradiation time on the stability of BN@CDs.

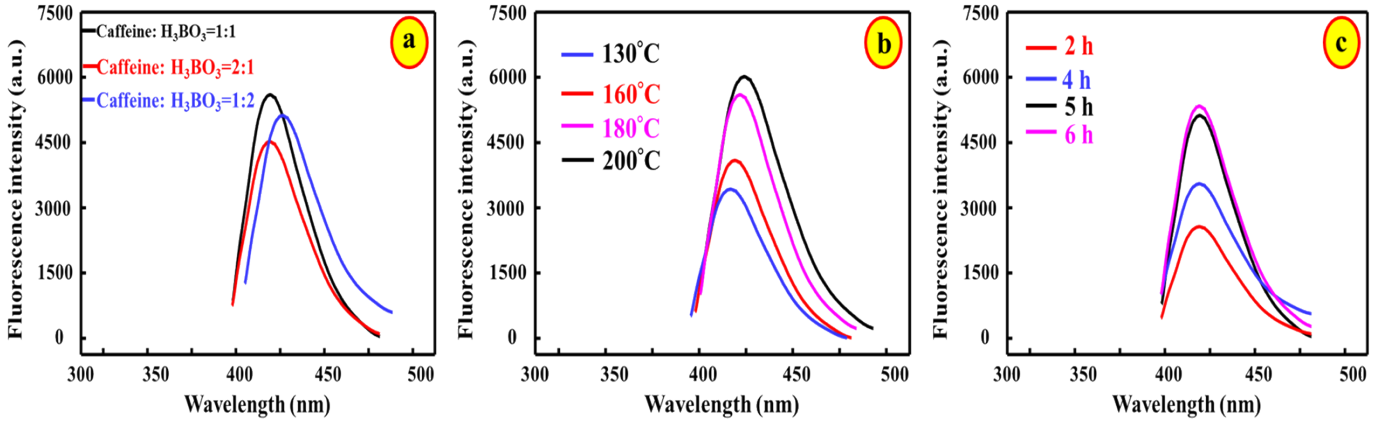

Fig.S3 The influence of (a) molar ratio of caffeine: H_3BO_3, (b) synthesis temperature, and (c) heating time (h) on the fluorescence emission of BN@CDs.

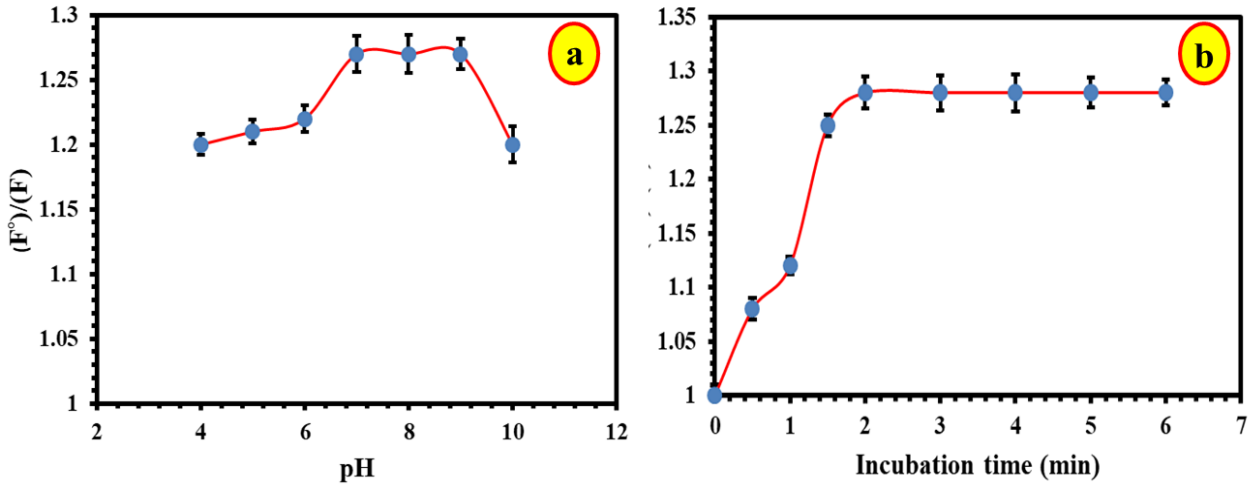

Fig.S4 The effect of (a) pH and (b) incubation time on the fluorescence quenching of BN@CDs by 5 μM Al^{3+}.

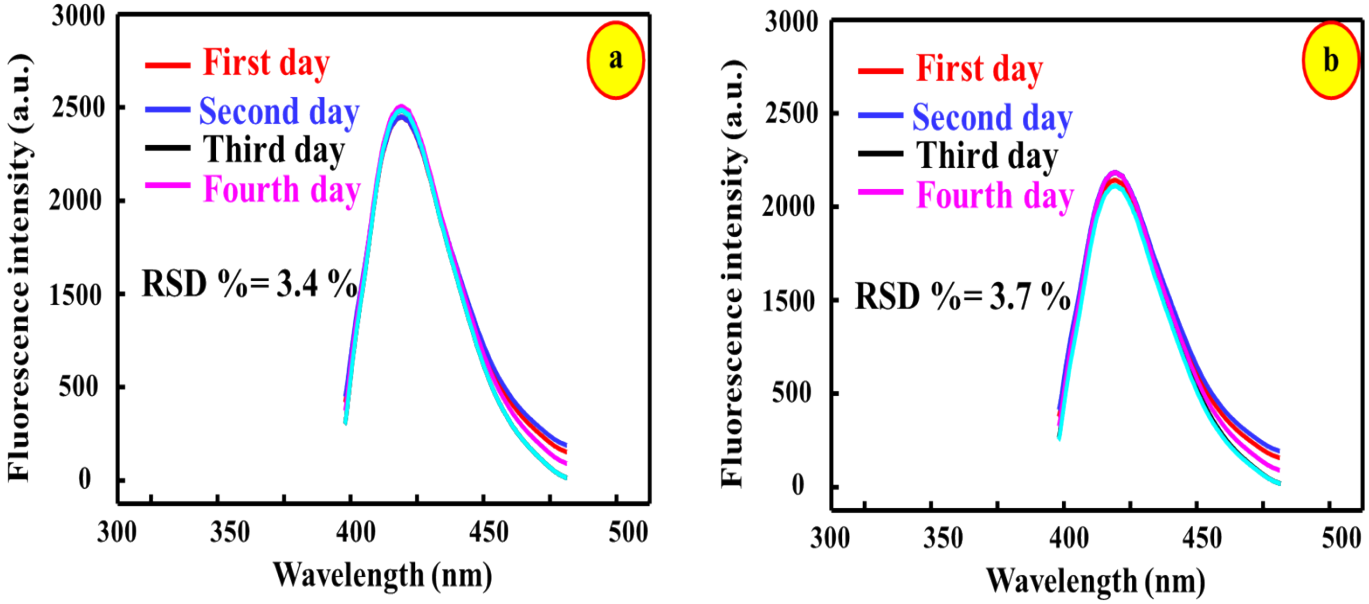

Fig.S5 Reproducibility of: (a) BN@CDs towards 25 µM Al^{3+}, (b) BN@CDs/Al^{3+} system towards 5 µM F^{-}.