# Supporting Information

# Leftover Kiwi Fruit Peel-Derived Carbon Dots as a Highly Selective Fluorescent Sensor for Detection of Ferric Ion

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## Materials

Green kiwi fruits were purchased from the supermarket, Republic of Korea. Aqueous ammonia ($NH_4OH$, 25%) and quinine sulfate were purchased from Sigma-Aldrich, Republic of Korea. The analytical grade of metal salts such as $AlCl_3$, $CaCl_2$, $Cd(CH_3OO)_2$, $Co(OOCH_3)_2$, $CrCl_3$, $CuCl_2$, $FeCl_3$, $HgCl_2$, $MnSO_4$, $NiCl_2$, $Pb(NO_3)_2$, and $ZnCl_2$ was purchased from Ducksan chemicals, Republic of Korea. All the chemicals were used as received and the deionized (DI) water was used throughout the experiments.

## Instrumentation Methods

The synthesized KN-CDs were characterized by various physicochemical techniques such as X-ray diffraction (XRD), Raman spectroscopy, Attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy, X-ray photoelectron spectroscopy (XPS), field emission scanning electron microscopy (FESEM) with energy-dispersive X-ray spectroscopy (EDS), transmittance electron microscopy (TEM)/high-resolution TEM (HRTEM), Ultraviolet-visible (UV-vis) absorption spectroscopy and fluorescence spectroscopy. The XRD measurements were carried out using a PANalytical X'Pert[3] MRD diffractometer with monochromatized Cu Kα radiation ($\lambda$ = 1.54 Å) at 40 kV and 30 mA and were recorded in the range from 10 to 80° ($2\theta$). Raman spectrum was recorded on the XploRA Micro-Raman spectrophotometer (Horiba) with the range between 50 and 4000 $cm^{-1}$ at the core research support center for natural products and medical materials of Yeungnam University. ATR-FTIR spectra were recorded in transmittance mode on a Perkin Elmer Spectrum Two in the wavenumber range from 400 to 4000 $cm^{-1}$ by the addition of 8 scans at a resolution of 8 $cm^{-1}$. XPS spectra were achieved using a K-Alpha (Thermo Scientific). CasaXPS software was used for the deconvolution of the high-resolution

XPS spectra. FESEM with EDS analysis was carried out on a Hitachi S-4800 equipped with EDX at an accelerating voltage of 10 kV. TEM images were performed using a JEOL JEM transmission electron microscope with an operating accelerating voltage of 120 kV. HRTEM images were performed with an FEI-Tecnai TF-20 transmission electron microscope with an operating accelerating voltage of 200 kV. UV-vis absorption spectra were recorded from 200 to 700 nm using an OPTIZEN 3220UV spectrophotometer. Excitation and emission fluorescence spectra were recorded using a Hitachi F-7000 fluorescence spectrophotometer. The excitation wavelength was varied to determine the maximum emission intensity was achieved by varying the excitation wavelength. The slit width was fixed at 5 nm and the scan speed was set to 400 nm/min.

***Quantum Yield Measurement of KN-CDs***

The quantum yield (QY) of the synthesized KN-CDs was calculated by using quinine sulfate in 0.1 M $H_2SO_4$ ($QY_R$ is 0.54) as a standard reference and was calculated using the following equation (S1):

$$QY = QY_R \frac{I_S A_R (n_S)^2}{I_R A_S (n_R)^2} \qquad (S1)$$

where, "I" is the measured integrated fluorescent emission intensity, "n" is the refractive index of the solvent, and "A" is the absorbance (intensity). The subscript "R" and "S" refer to the known fluorescent reference and standard for the synthesized sample, respectively.

### *Photobleaching and Prolonging Stability of KN-CDs*

The photobleaching stability of the synthesized KN-CDs 1 and KN-CDs 2 was examined under UV light (365 nm) irradiation for 60 min with an interval of every 30 min. For the prolonging stability measurement, the aqueous KN-CDs 1 and KN-CDs 2 solutions were stored for a long time and the fluorescence intensity of the aqueous KN-CDs solutions were measured in different storage time intervals.

### *Sensing of Metal Ions*

Sensing of $Fe^{3+}$ ion was performed using a 1 cm path length quartz cell at room temperature with a fluorescence excitation wavelength of 360 nm. The fluorescence emission spectra for the mixture of KN-CDs (0.5 mL) and DI water (0.5 mL) were measured as a blank. The selectivity for $Fe^{3+}$ sensing of KN-CDs was confirmed by adding 0.5 mL of twelve different common metal ions solutions ($Al^{3+}$, $Ca^{2+}$, $Cd^{2+}$, $Co^{2+}$, $Cr^{3+}$, $Cu^{2+}$, $Fe^{3+}$, $Hg^{2+}$, $Mn^{2+}$, $Ni^{2+}$, $Pb^{2+}$ and $Zn^{2+}$ ions) with a concentration of 1 mM to 0.5 mL of the aqueous KN-CDs solution. The fluorescence emission spectra were recorded after reaction for 30 seconds at room temperature by adopting the same procedure as that of a blank sample. Then, the sensitivity of $Fe^{3+}$ ion in the presence of KN-CDs was conducted as follows; 0.5 mL of KN-CDs was taken in the quartz cell, followed by the addition of 0.5 mL of various concentrations of $Fe^{3+}$ ion (5–25 μM), the fluorescence intensity was recorded after 30 seconds of interaction time.
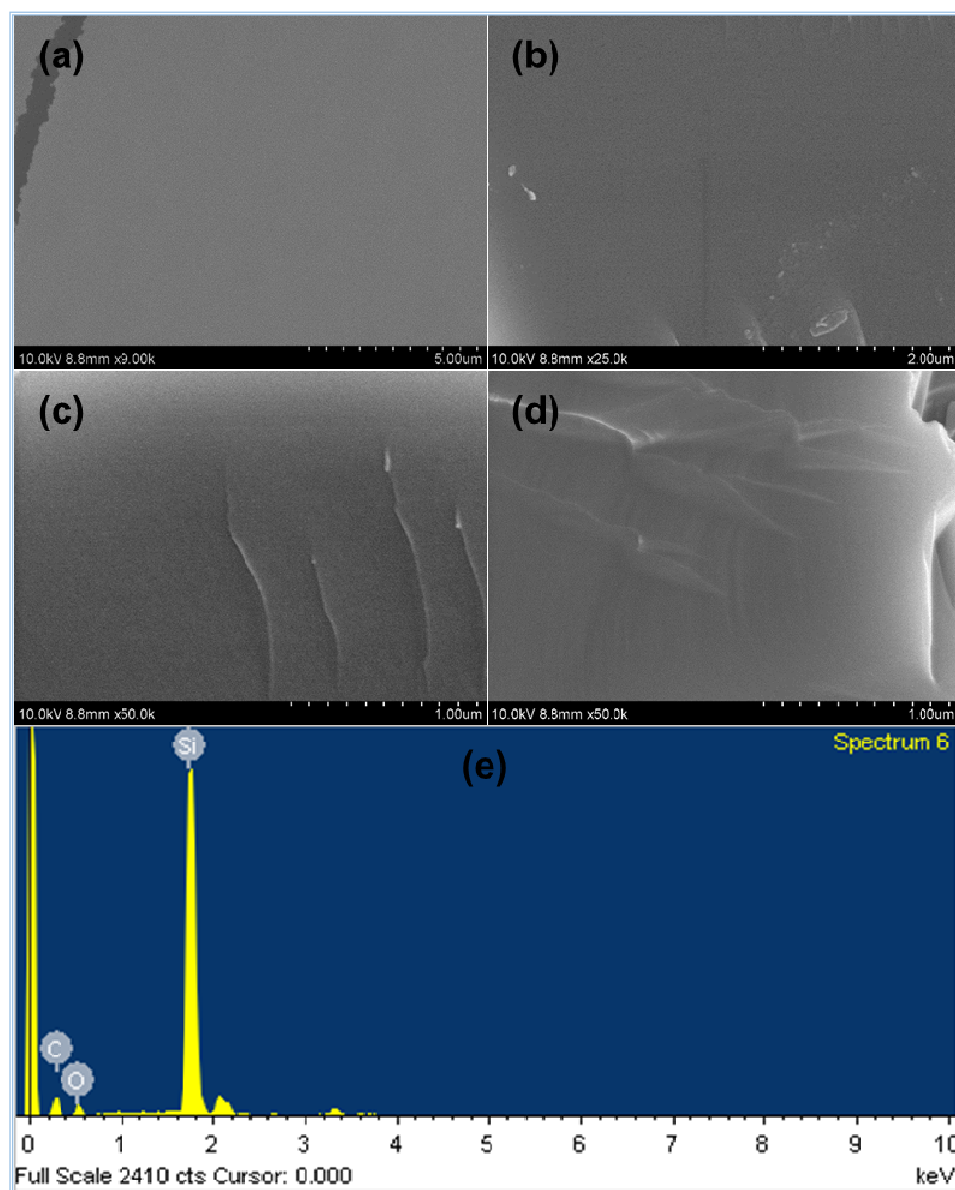
*Characterization of Synthesized KN-CDs*
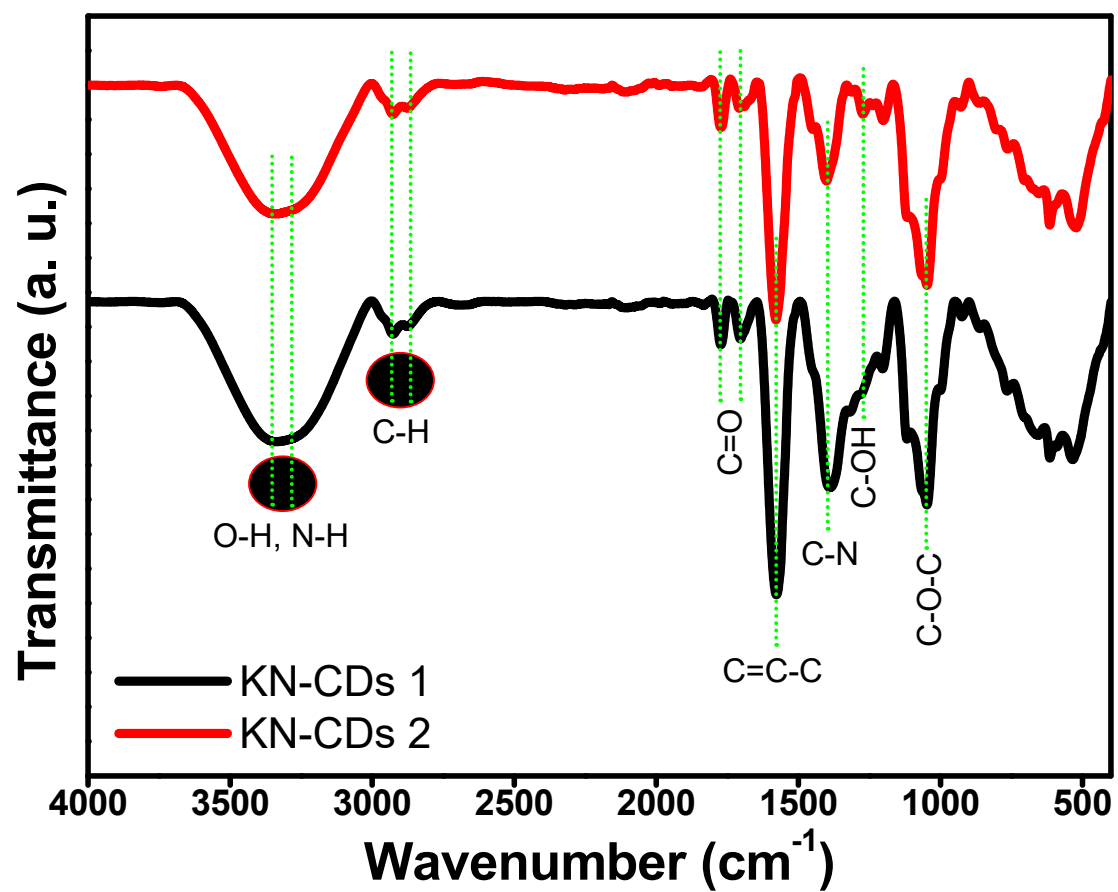


**Fig. S1** ATR-FTIR spectra of KN-CDs 1 and KN-CDs 2.
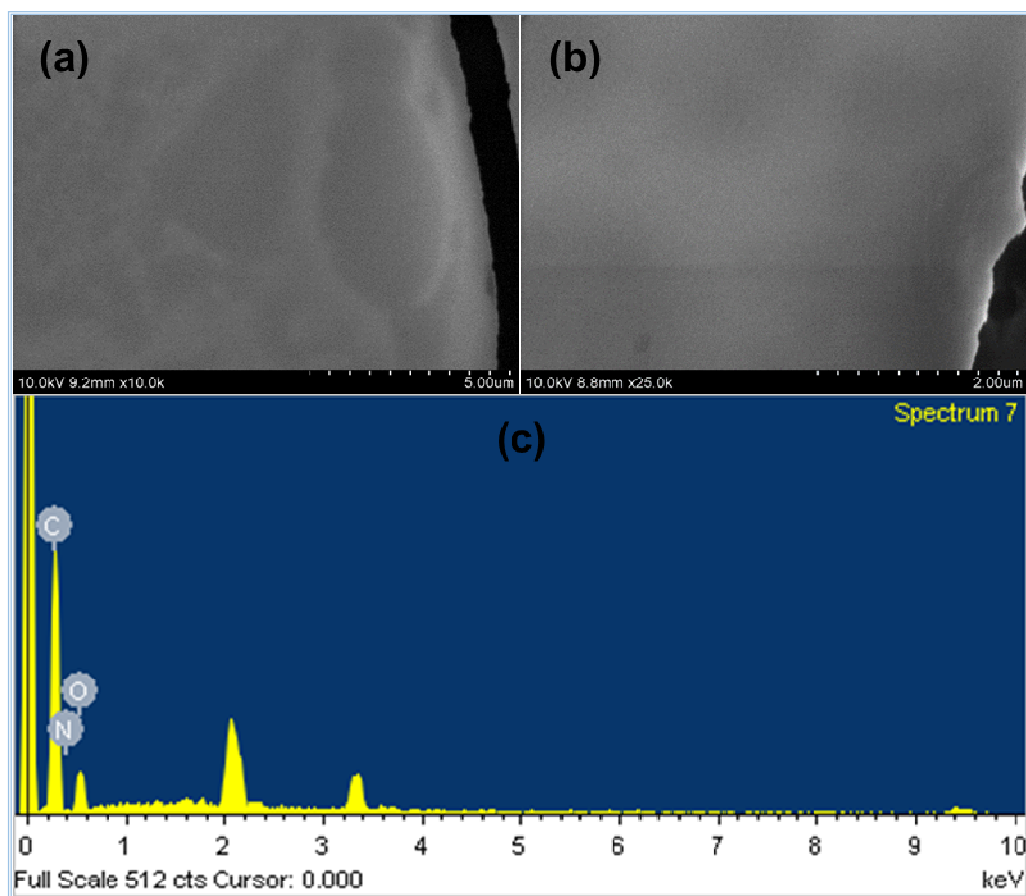
**Fig. S2** (a and b) FESEM images with different magnifications and (c) EDX spectrum of KN-CDs 1.

**Fig. S3** (a-d) FESEM images of KN-CDs 2 with different magnifications and (e) the corresponding EDX spectrum.