Supporting Information

Nanopaper-based screen-printed electrode: A hybrid sensing bioplatform for dual opto-electrochemical sensing applications

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The assembly and setup of photometer

The assembled photometer, as schematically shown in Figure S2-A, consists of a far-red light power LED (Epileds, Taiwan, with λ=710 nm, light intensity 80-90 Lm, 3.0-3.4 V, and maximum electric current 350 mA) as light source; a silicon photodiode (Hamamatsu S1223-01 full spectrum Si photodiode, through-hole TO-5, Japan) as detector; a converging lens with 20 mm focal length and a collimator lens with D 25.4 mm (Changchun Yutai Optics Co., Ltd. China), which were used to focus the light on the detection zone and silicon photodiode, respectively; an ADC (analog to digital converter) AVR® 8-bit ATMega32 microcontroller (Silicon TechnoLabs, India); an electronic board; a pre-processing signal module; and USB module for connecting to the computer. A data software was also written in C sharp to control the LED-based photometer through a USB interface and for data acquisition. A sandwich-structured electrode holder with a three-pin connector was designed, as shown in Figure S2-B and 2C, which fixes the fabricated BC-SPE platform by Plexiglass (Poly(methyl methacrylate)) electrode holders during opto-electrochemical experiments. A photograph of the assembled photometer with the designed electrode holder is also displayed in Figure S2- D.

Depending on the target analyte and consequently the required wavelength, the LED light source can be changed. Changing in absorbance (ΔA) of the BC-SPE platform is monitored by using the assembled photometer for quantitative optical detection of analytes, and at the same time, the electrochemical modulation can be recorded by using a potentiostat, which is connected via the three-pin connector to the fabricated BC-SPE for electrochemical detection.
Figure S1 Contact angle images for droplets water on (A) BC nanopaper (non-printed), and (B) printed BC nanopaper. Contact Angle: CA

Figure S2 (A) Cross-section representation of LED-based photometer assembly. (B) A picture of the fabricated sandwich-structured electrode holder with a three-pin connector. (C) A photograph showing the sample casting on the BC-SPE fixed inside the fabricated electrode holder. (D) A photograph of the assembled LED-based photometer with the electrode holder.
Figure S3 (A) CV of K₃Fe(CN)₆ (10 mM)/KCl (0.1 M) at a scan rate of 50 mV/s on the surface of the BC-SPE platform. (B) Cyclic voltammetry measurements of K₃Fe(CN)₆ (10 mM)/ KCl (0.1 M) on the surface of the fabricated BC-SPE platforms at various scan rates: a) 25, b) 50, c) 75, d) 100, e) 150 mV/s. (C) Plots of \( i_{pc} \) vs. \( \nu^{1/2} \) and \( i_{pa} \) vs. \( \nu^{1/2} \) for K₃[Fe(CN)]₆ on the surface of the fabricated BC-SPE platforms.

Figure S4 (A) CVs of fresh aqueous solution (10 mM K₃Fe(CN)₆ + 2 mM FeCl₃ + 0.1 M KCl + 10 mM HCl) on the surface of the BC-SPE in the potential range of -300–1000 mV, at a scan rate of 50 mV/s. (B) Absorbance at 710 nm (LED source) vs number of CV scans (Inset shows the variation of color during application of CV cycles).
**Figure S5** (A) Schematic mechanism for acetaminophen sensing using the developed BC-SPE through synthesis of PB. (B) CVs of solutions (K$_3$Fe(CN)$_6$ (10 mM)/ KCl (0.1 M), in the absence (blue) and presence (red) of 30 µM acetaminophen casted on the opto-electrochemical window of the developed BC-SPE platform, at a scan rate of 50 mV/s. (C) CVs of solutions (K$_3$Fe(CN)$_6$ (10 mM)/ FeCl$_3$ (10 mM)/ KCl (0.1 mM), and different concentrations of acetaminophen (10-100 µM)) casted on the opto-electrochemical window of the developed BC-SPE platform, at a scan rate of 50 mV/s.
**Figure S6** A photograph of the fabricated dark chamber for ECL image capturing on BC-SPE.