Supplementary Information (SI) for RSC Advances.
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Fluorescence nanoprobes bearing low temperature derived biochar nanoparticles as efficient quenchers for detection of single-stranded DNA and 17β-estradiol and analytical potential

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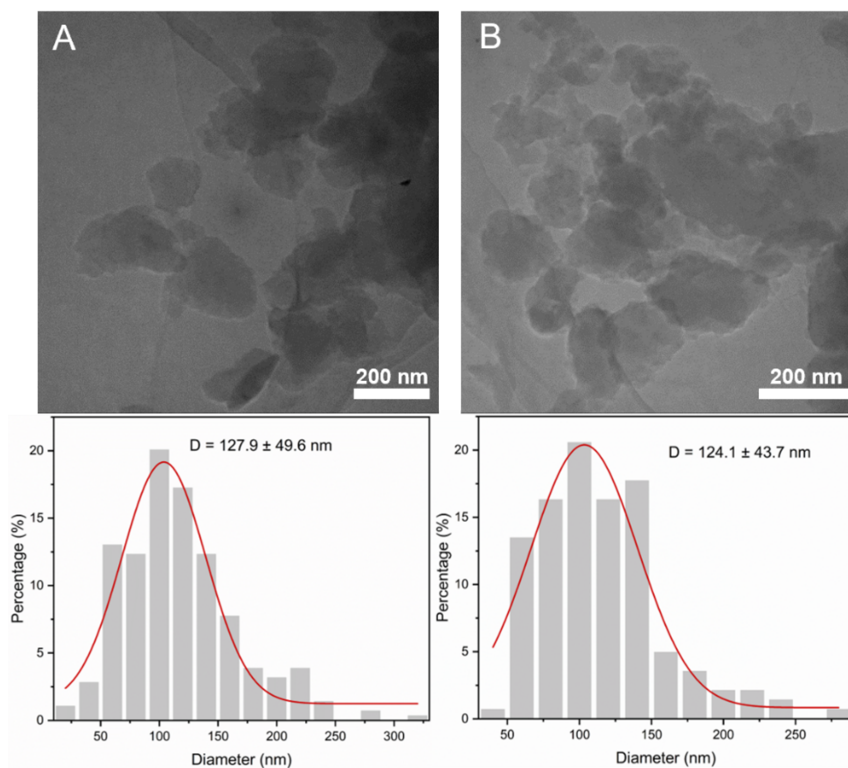

Fig. S1 BQNPs images and size distributions of the second (A) and fourth (B) batches. The size distribution of BQNPs was determined by quantitative analysis of TEM images. Over 200 nanoparticles were measured.

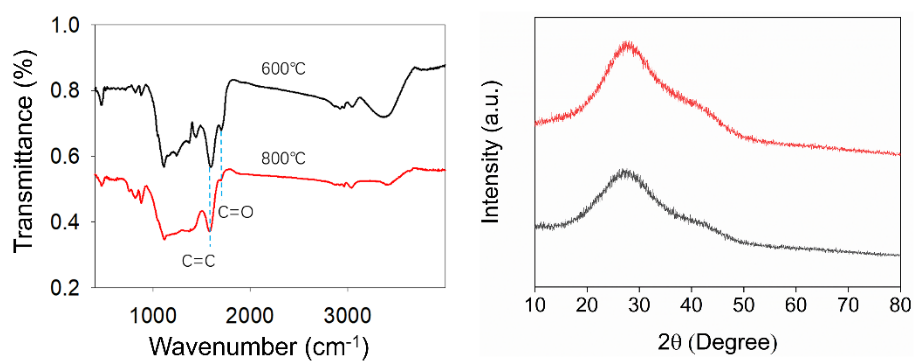

Fig. S2 (A) FTIR spectra of BQNPs prepared at pyrolysis temperatures of 600 ℃ and 800 ℃. (B) XRD of BQNPs before (black line) and after DNA probe adsorption (red line).

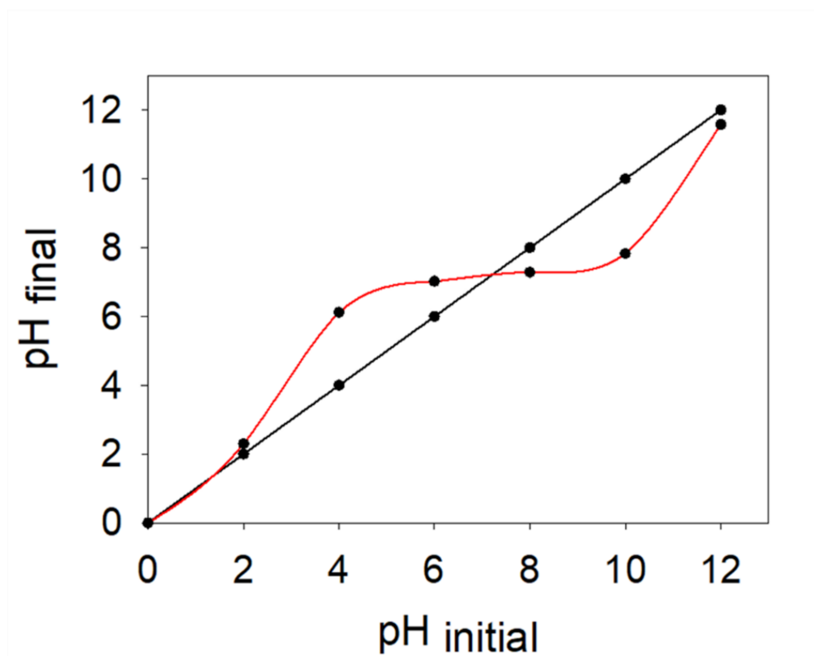

Fig. S3 Plot for determination of isoelectric point of BQNPs prepared at 400 ℃ (black line, $pH_{initial}$ vs pH_{final} (without BQNPs); red line, $pH_{initial}$ vs pH_{final} (with BQNPs). 20 mg of the BQNPs were dispersed in 10 mL of the NaCl solutions with the various pHs (2, 4, 6, 8, 10 and 12). This was followed by incubation at room temperature for 48 h, and after that, the pH of each solution was measured using a pH meter. The point of intersection of the "pH_{final} vs $pH_{initial}$" curves represent the isoelectric point of the adsorbent.

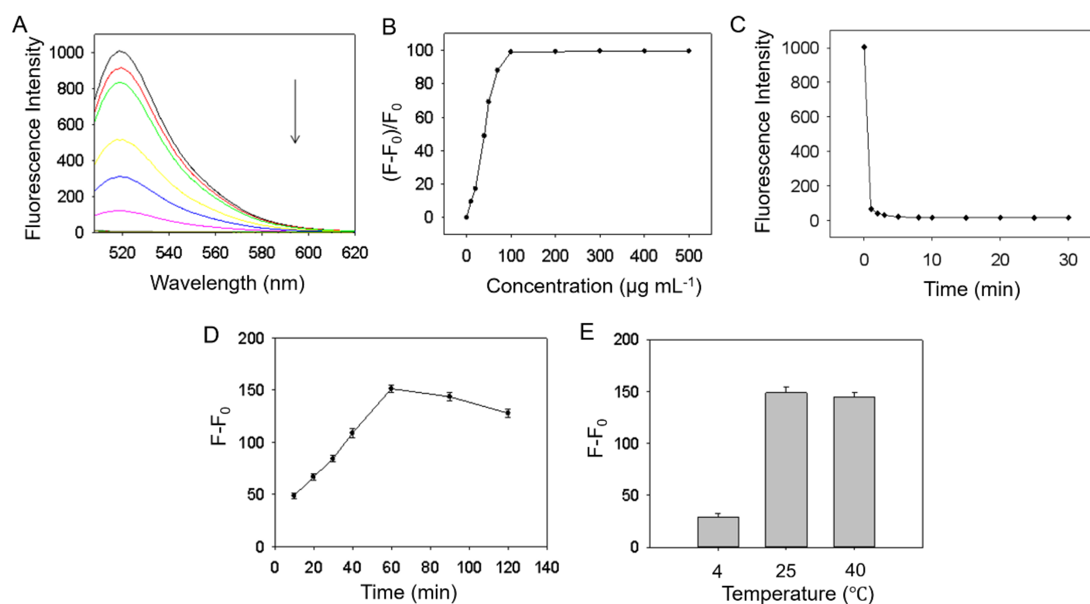

Fig. S4 (A) Fluorescence spectrum of DNA probe (30 nM) incubated with various concentrations of BQNPs (0, 10, 20, 30, 50, 80, 100, 200, 300, 400 and 500 μg mL^{-1}), and (B) Profiles of fluorescence quenching efficiency depending on the various concentrations of the BQNPs (0, 10, 20, 30, 50, 80, 100, 200, 300, 400 and 500 μg mL^{-1}). (C) Time dependent change of fluorescence intensities by quenching of the DNA probe (30 nM) with BQNPs (100 μg mL^{-1}). (D) The change of fluorescence intensities $(F - F_0)$ upon various incubation times and (E) at various temperatures during detection of tDNA (100 nM). F_0 and F are fluorescence intensities in the absence and presence of the tDNA, respectively. The error bars represent standard deviations from triplicate measurements.

Table S1. Comparison of the different methods for DNA detection

Detection methods	Linear range (nM)	Detection limit (nM)	References
Electrochemical	1 - 2000	0.7	[1]
Electrochemical	-	0.3	[2]
Colorimetric	-	10	[3]
Fluorescent	15 - 150	3.18	[4]
Fluorescent	10 - 200	1.18	[5]
Fluorescent	2 - 50	1.04	This work

Table S2. Comparison of the different methods for E2 detection

Detection methods	Linear range ($ng\ mL^{-1}$)	Detection limit ($ng\ mL^{-1}$)	References
Electrochemical	0.26 - 2.64	1.4	[6]
Electrochemical	27.2 -54400	28.6	[7]
Colorimetric	20 - 10000	20	[8]
Fluorescent	1 - 50	0.34	[9]
Fluorescent	0.13 - 54	0.13	[10]
Fluorescent	1 - 20	0.4	This work

SI References

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