

Supplemental Information for

Cubic Boron Nitride with an Intrinsic Peroxidase-Like Activity

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Figure S1. Typical photographs of TMB reaction solution catalytically oxidized by the c-BN in the presence of H₂O₂ incubated at 45°C in 3.1 mL of pH 4.0 citrate-phosphate buffer: (1) 100 mM H₂O₂ and 1mM TMB, colorless; (2) 1 mM TMB and 0.25 mg ml⁻¹ c-BN, colorless; (3) 100 mM H₂O₂ and 0.25 mg ml⁻¹ c-BN, colorless; (4) 100 mM H₂O₂, 1 mM TMB and 2 mg ml⁻¹ c-BN (size 4-8 μm), turning blue. Note that after reaction finished, c-BN was removed from the solution.

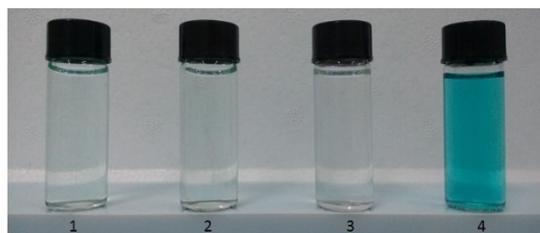
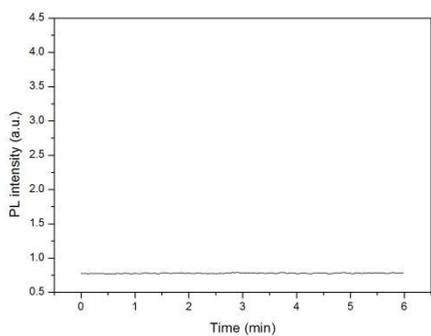
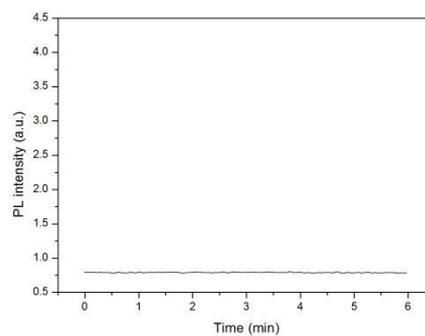


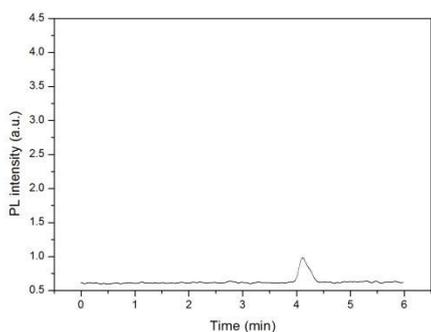
Figure S2. Chromatogram of phosphate solutions (pH 6.0) containing only (a) TA, (b) TA and c-BN, (c) TA and H₂O₂, or (d) TA, c-BN and H₂O₂ after a reaction time of 12 hours. The TA, H₂O₂, and c-BN concentrations were 2.5 mM, 979 mM, and 0.5 mg ml⁻¹, respectively. (e) Chromatogram of 2.5 mM 2-Hydroxyterephthalic Acid (HTA).



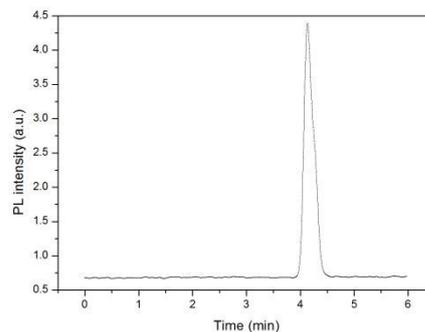
(a)



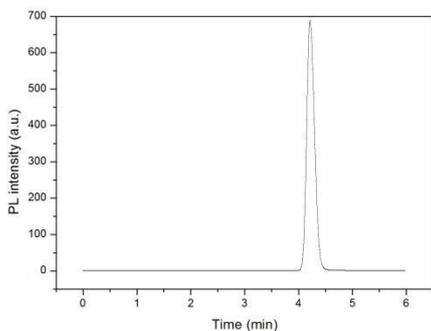
(b)



(c)

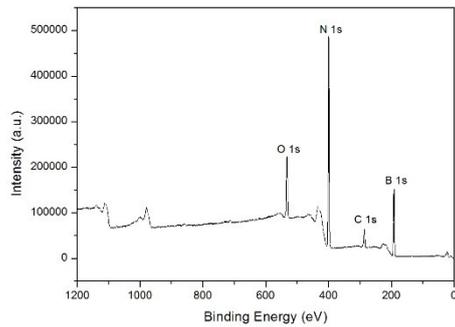


(d)

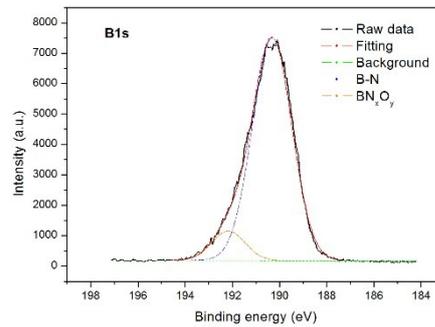


(e)

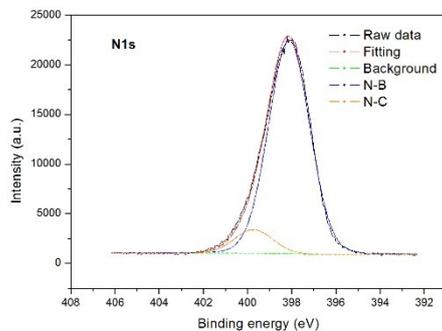
Figure S3. (a) XPS survey scans of c-BN. High resolution (b) B1s, (c) N1s, (d) O1s and (e) 1Cs scans of c-BN. (f) FTIR spectra of c-BN. The XPS spectrum of the c-BN exhibits three peaks at 190.28, 398.11, 531.68 and 284.80 eV, which are attributed to B1s, N1s, O1s and C1s, respectively. High resolution spectra of B1s regions show the presence of B-N at 190.31 eV as the major feature and the relatively small peak at 192.17 eV was attributed to BN_xO_y . The occurrence of ternary BN_xO_y species may result from a substitution of nitrogen atoms by oxygen atoms. High resolution spectra of N1s regions shows the N-B located at 398.12 eV as the major feature and relatively small peak at 399.73 eV is assigned to N-C. High resolution spectra of O1s regions shows BN_xO_y and O=C at 532.40 and 531.00, respectively. In the case of C1s regions, the peaks centered at 284.80, 285.70 and 288.30 eV are assigned to C-C, C-N and C=O, respectively. The occurrence of C-C and C=O are attributed to the surface contamination of hydrocarbon impurities possessing C-C and C=O bonds.



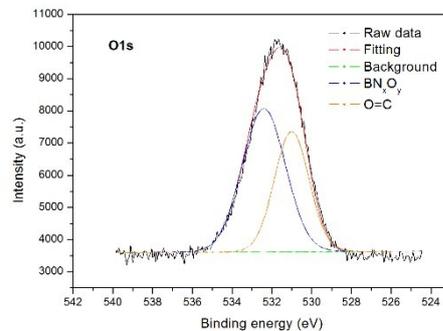
(a)



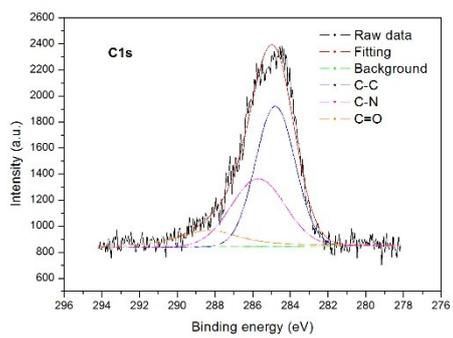
(b)



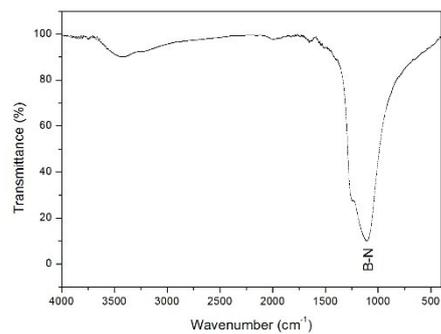
(c)



(d)



(e)



(f)

Figure S4. Image of the TMB–H₂O₂ mixed solution in the presence of h-BN of different sizes (5-20 nm, 50 nm, 1 μm and 1-2 μm). Note that after reaction finished, h-BN was removed from the solution.

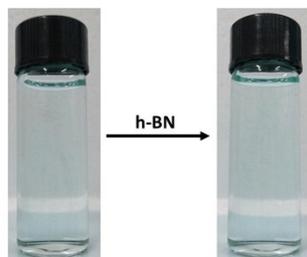
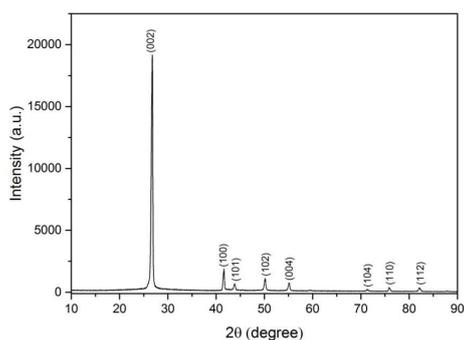
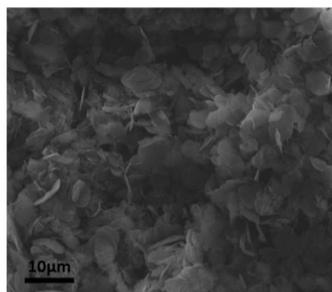


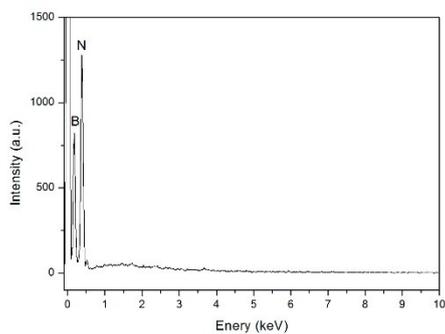
Figure S5. (a) XRD pattern of h-BN. All reflections can be indexed to hexagonal form boron nitride (JCPDS No. 73-2095). (b) SEM image of h-BN. (c) Correspondent EDX spectra showing the presence of boron (B) and nitrogen (N). (d) FTIR spectra of h-BN. It only shows the existence of B-N (around 1372 cm^{-1} and 814 cm^{-1} , respectively).



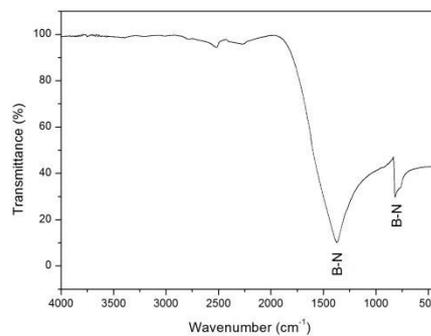
(a)



(b)



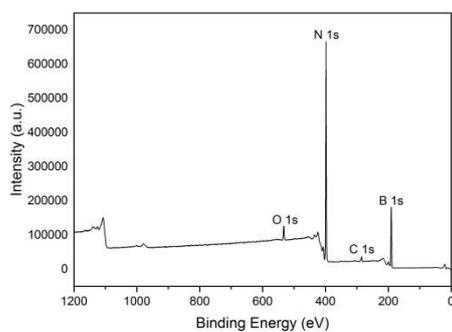
(c)



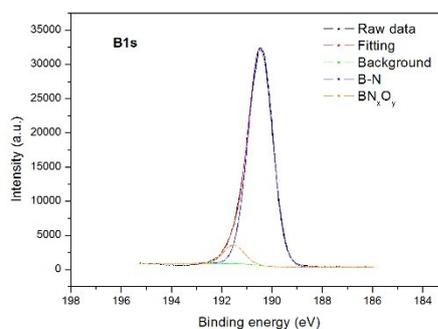
(d)

Figure S6. (a) XPS survey scans of h-BN. High resolution (b) B1s, (c) N1s, (d) O1s and (e) 1Cs scans of h-BN.

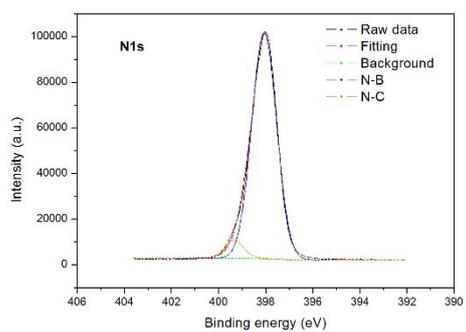
The XPS spectrum of the c-BN exhibits three peaks at 190.47, 398.11, 532.20 and 284.80 eV, which are attributed to B1s, N1s, O1s and C1s, respectively. It demonstrates that the h-BN are mainly composed of B (50.74%) and N (40.95%) elements. The ration of B to N is shown as 1.24, revealing the existence of nitrogen vacancy defects on the surface. High resolution spectra of B1s regions show the presence of B-N at 190.46eV as the major feature and the relatively small peak at 191.52 eV is attributed to BN_xO_y . The occurrence of ternary BN_xO_y species may result from a substitution of nitrogen atoms by oxygen atoms. High resolution spectra of N1s regions shows the N-B located at 398.06 eV as the major feature and relatively small peak at 399.31eV is assigned to N-C. High resolution spectra of O1s regions shows BN_xO_y and O=C at 532.60 and 531.20 eV, respectively. In the case of C1s regions, the peaks centered at 284.80, 285.70 and 288.30 e V are assigned to C-C, C-N and C=O, respectively. The occurrence of C-C and C=O are attributed to the surface contamination of hydrocarbon impurities possessing C-C and C=O bonds.



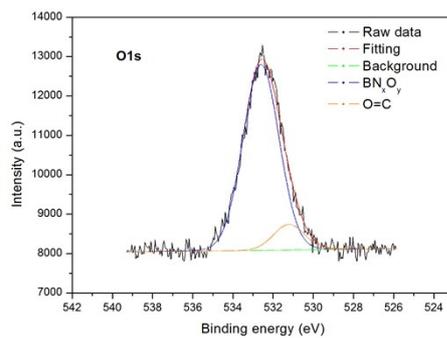
(a)



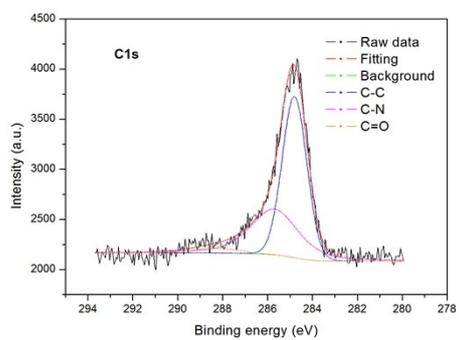
(b)



(c)

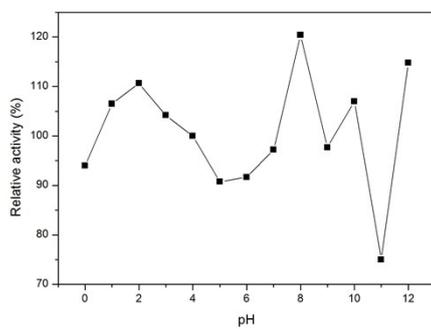


(d)

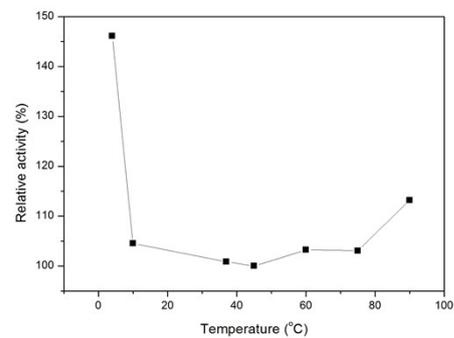


(e)

Figure S7. Robustness of peroxidase activity of c-BN. (a) C-BN was first incubated at a range of values of pH from 0 to 12 for 2 hours and then its peroxidase activity was measured at 45°C in pH 4.0 citrate-phosphate buffer. The peroxidase activity of c-BN incubated at pH 4.0 was set as 100%. (b) C-BN was first incubated at a range of temperatures between 4 and 90°C for 2 hours and then the peroxidase activity was measured at 45°C in pH 4.0 citrate-phosphate buffers. The peroxidase activity of c-BN incubated at 45°C was set as 100%.



(a)



(b)

Figure S8. Catalytic degradation of RhB in the presence of H_2O_2 and c-BN.

