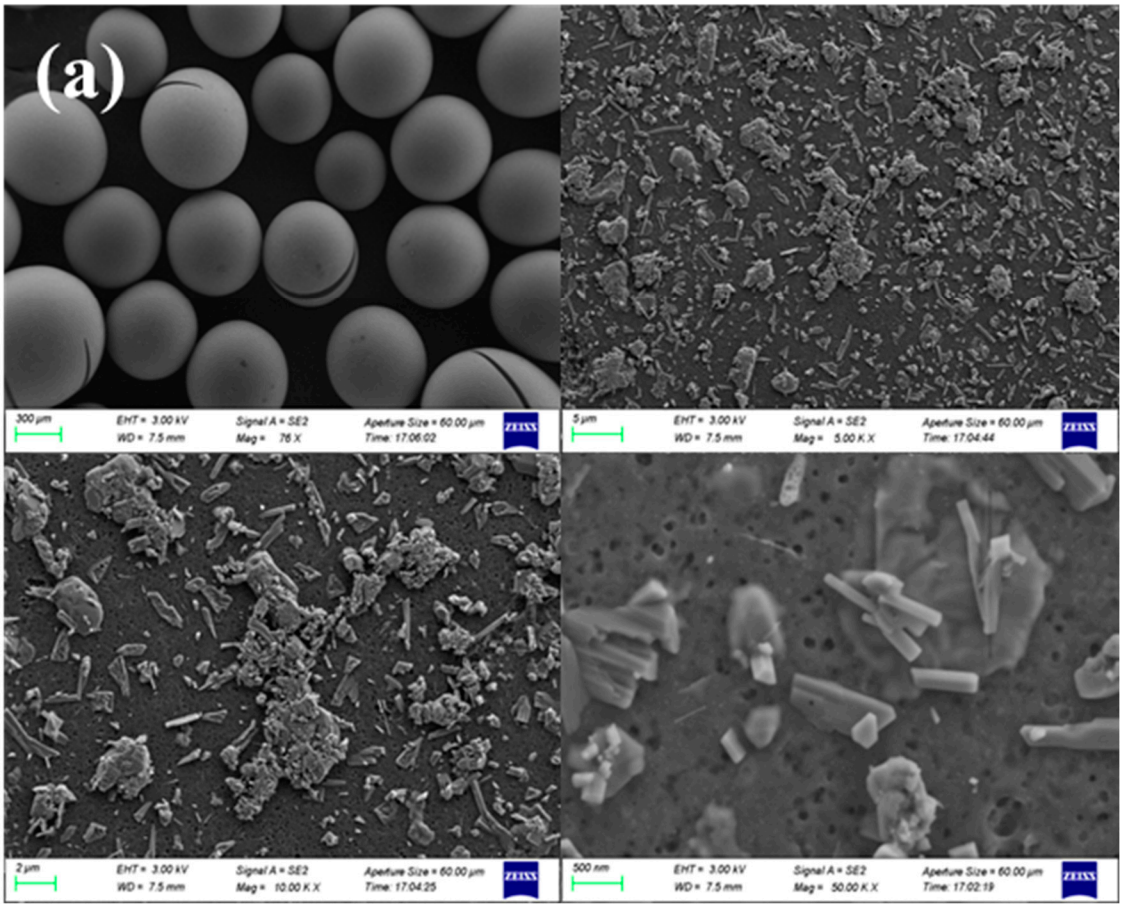
water

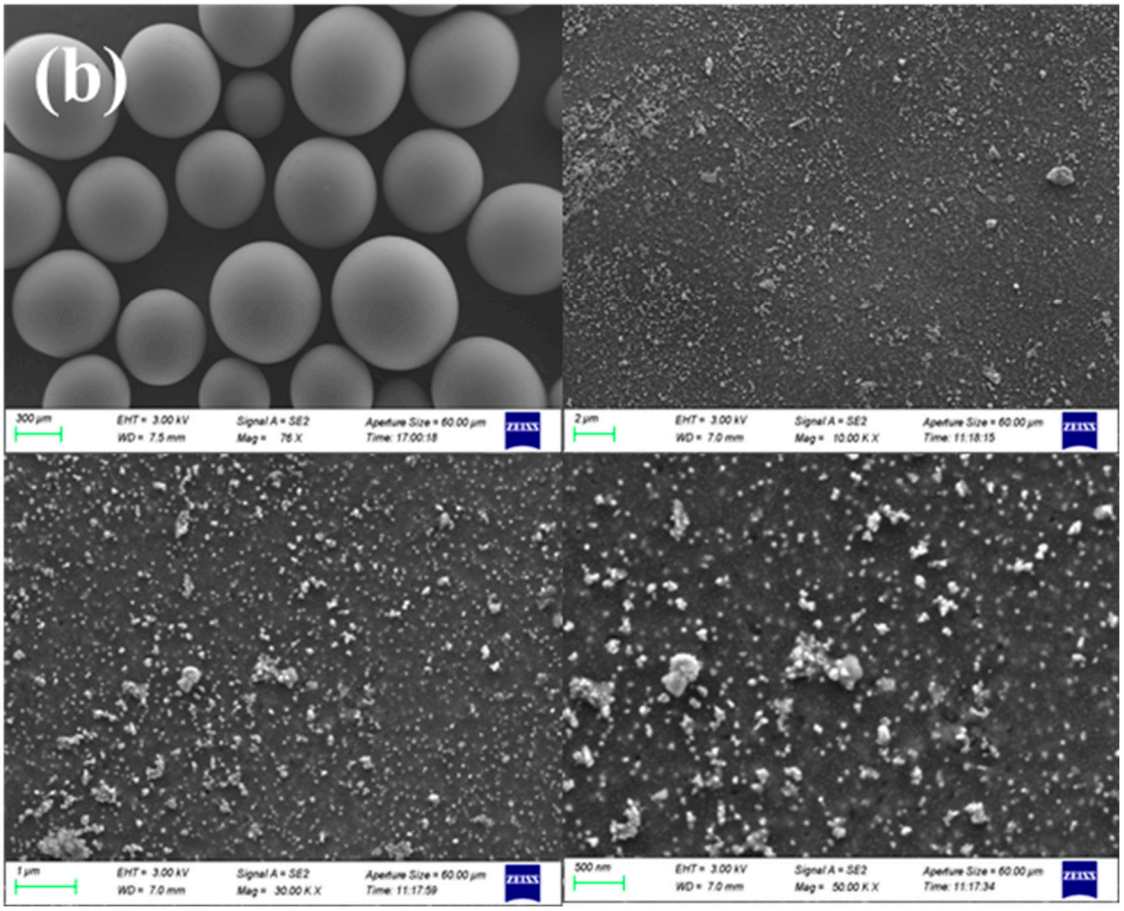
MDPI

# Nitrogen doped cobalt anchored on the used resin-based carbon ball catalyst to activate peroxymonosulfate for the degradation of ibuprofen

**Cheng Wang [a], Guangzhen Zhou [a], Yanhua Xu [a], Yongjun Sun [b,*] and Peng Yu [a]**

[a] School of Environmental Science and Engineering, Nanjing Tech University, Nanjing, 211816, China
[b] College of Urban Construction, Nanjing Tech University, Nanjing, 211816, China
* Correspondence: Author: Yongjun Sun
Fax: +86-025-58139652
E-mail: sunyongjun@njtech.edu.cn


(a)
300 µm EHT = 3.00 kV WD = 7.5 mm Signal A = SE2 Mag = 76 X Aperture Size = 60.00 µm Time: 17:06:02
5 µm EHT = 3.00 kV WD = 7.5 mm Signal A = SE2 Mag = 5.00 K X Aperture Size = 60.00 µm Time: 17:04:44
2 µm EHT = 3.00 kV WD = 7.5 mm Signal A = SE2 Mag = 10.00 K X Aperture Size = 60.00 µm Time: 17:04:25
500 nm EHT = 3.00 kV WD = 7.5 mm Signal A = SE2 Mag = 50.00 K X Aperture Size = 60.00 µm Time: 17:02:19


(b)
300 µm EHT = 3.00 kV WD = 7.5 mm Signal A = SE2 Mag = 76 X Aperture Size = 60.00 µm Time: 17:00:18
2 µm EHT = 3.00 kV WD = 7.0 mm Signal A = SE2 Mag = 10.00 K X Aperture Size = 60.00 µm Time: 11:18:15
1 µm EHT = 3.00 kV WD = 7.0 mm Signal A = SE2 Mag = 30.00 K X Aperture Size = 60.00 µm Time: 11:17:59
500 nm EHT = 3.00 kV WD = 7.0 mm Signal A = SE2 Mag = 50.00 K X Aperture Size = 60.00 µm Time: 11:17:34

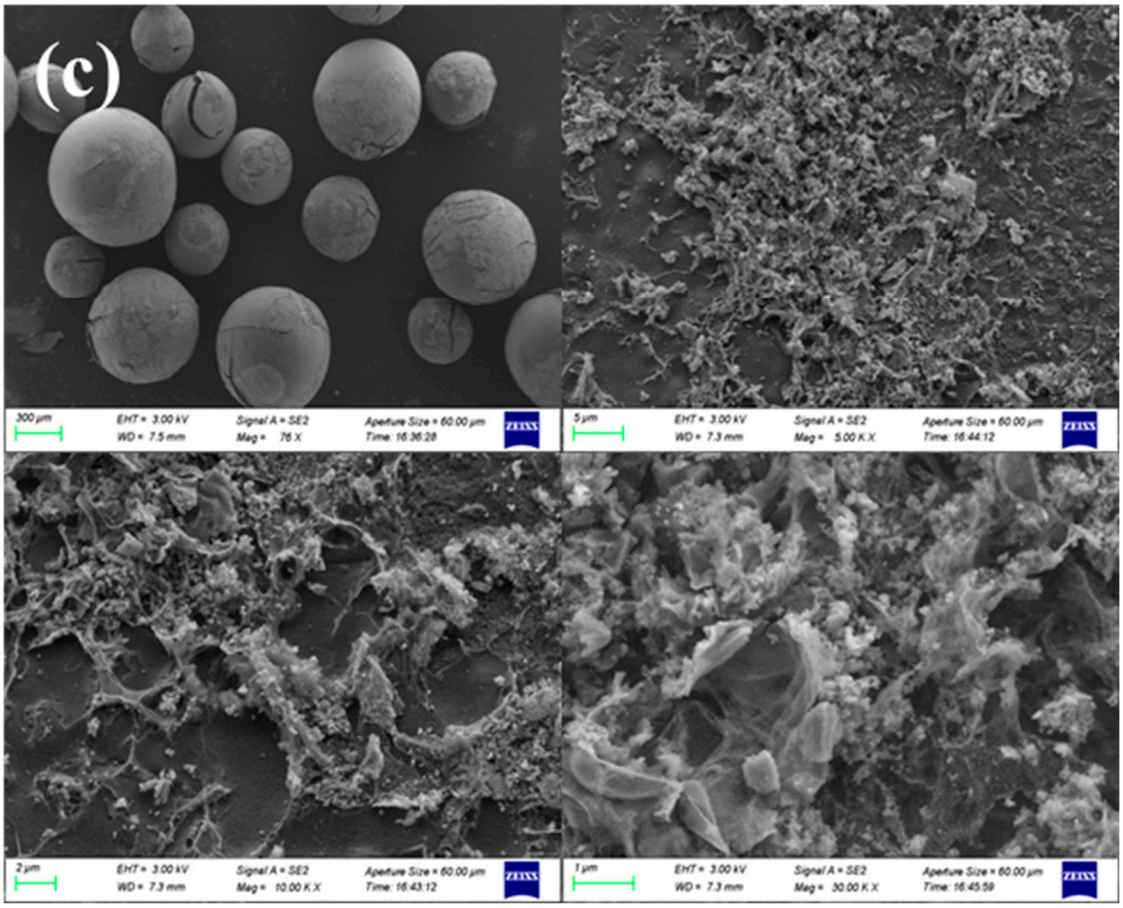



**Figure S1.** More SEM characterization graph of carbon ball materials; D001CB (a); Co/D001CB (b); N-Co/D001CB (c).

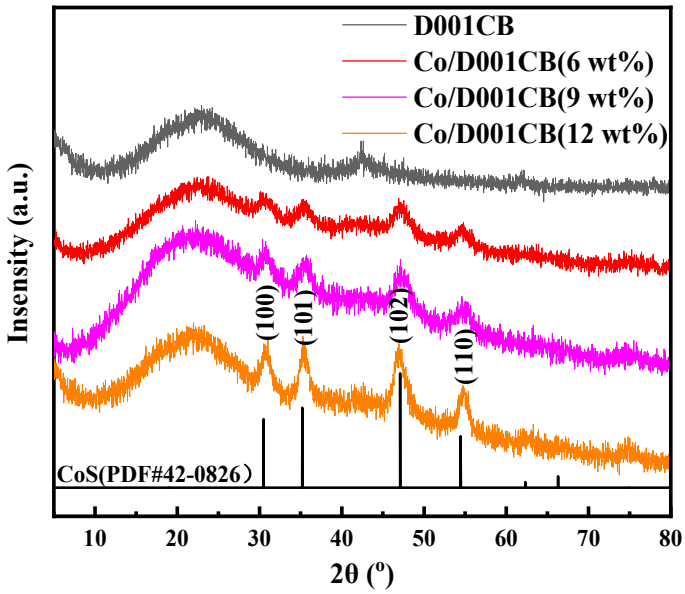



**Figure S2.** XRD of carbon spheres with different cobalt doping.

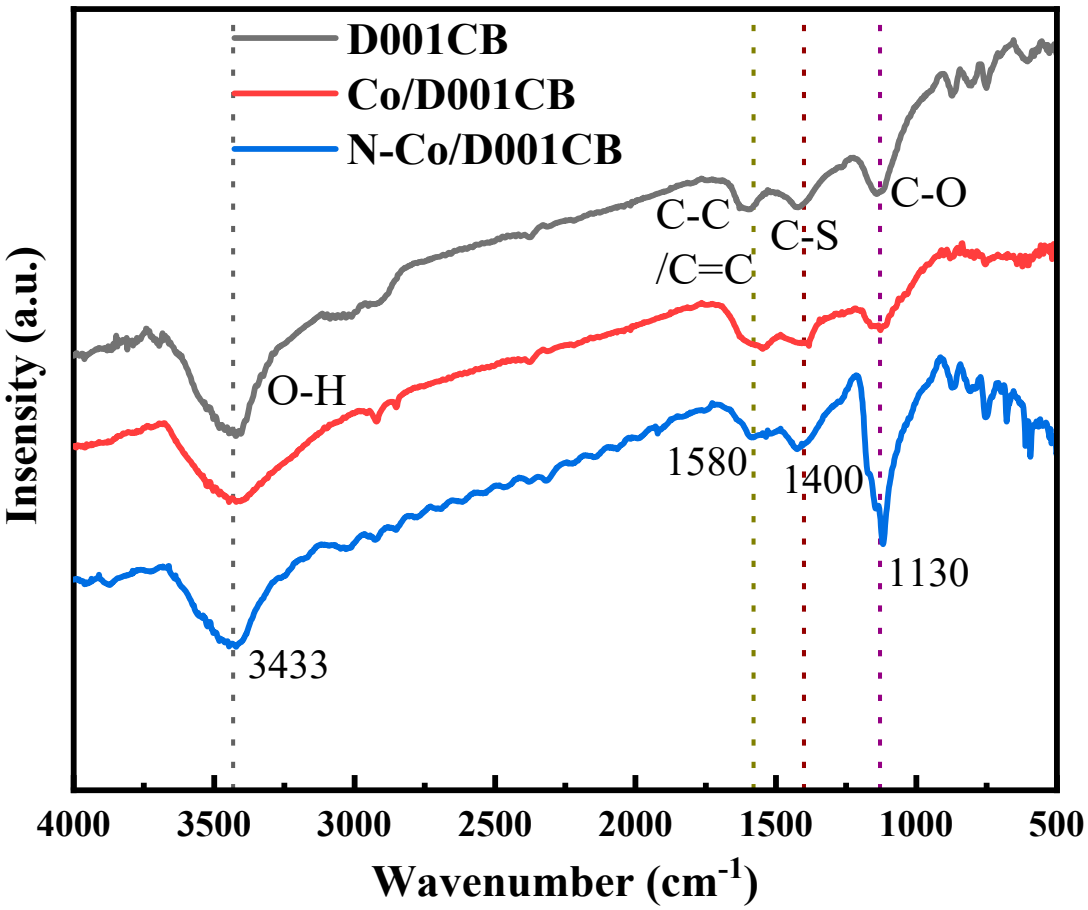



**Figure S3.** FT-IR spectrums of D001CB，Co/D001CB and N-Co/D001CB.

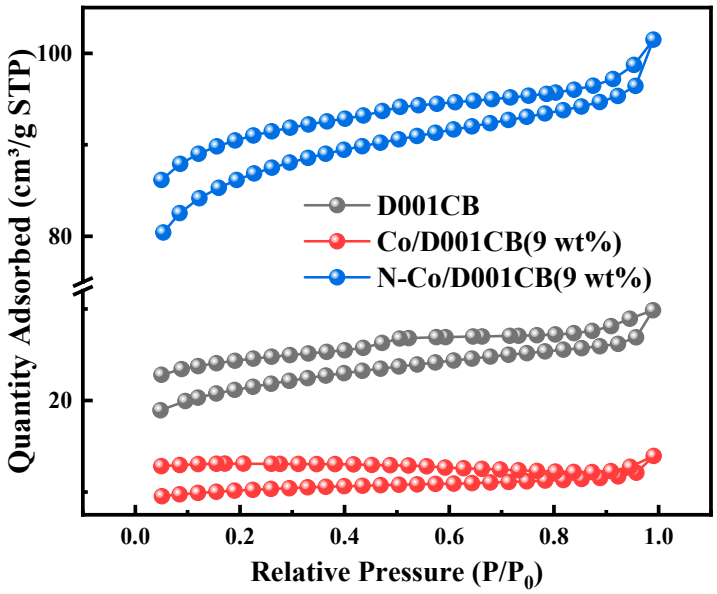



**Figure S4.** Nitrogen adsorption desorption curves of D001CB, Co/D001CB, N-Co/D001CB.

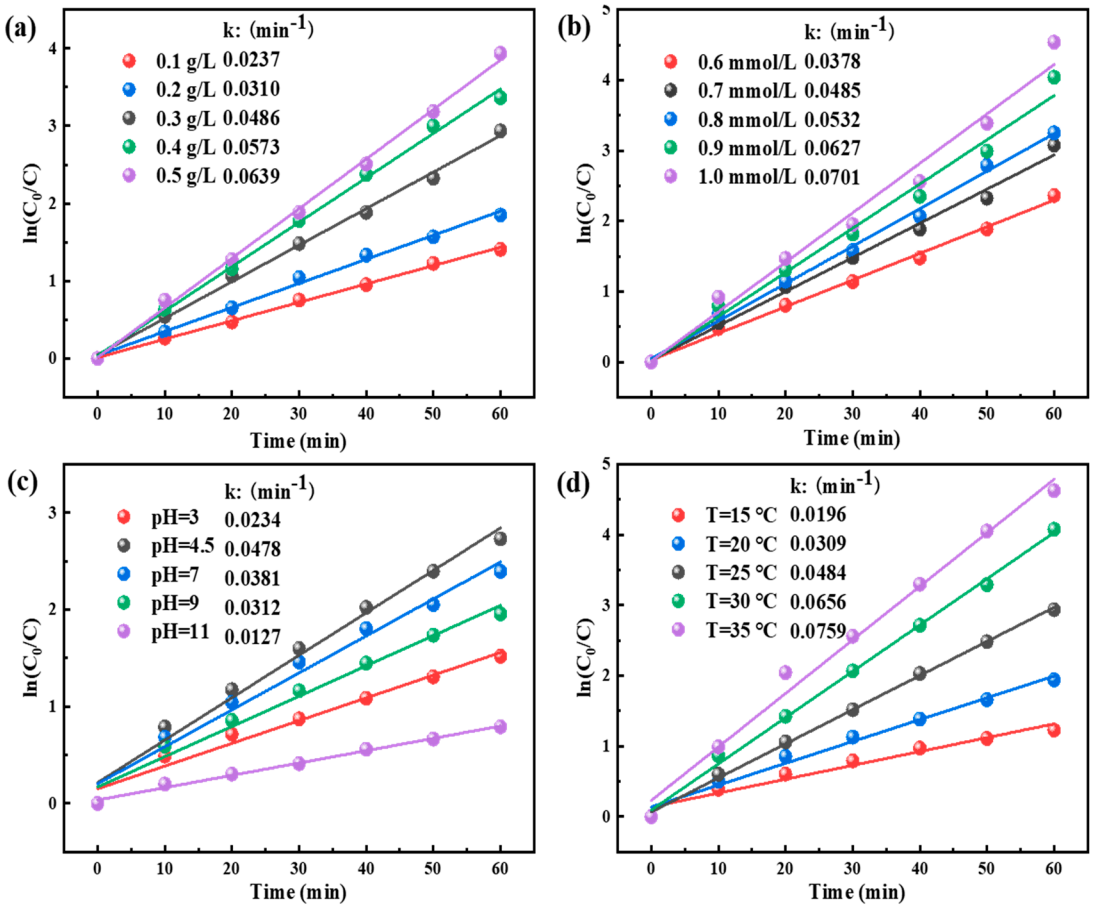



**Figure S5.** Kinetic fitting for the catalytic degradation of ibuprofen under different reaction conditions, catalyst loading (a, Temperature = 25 °C, pH = 4.5, PMS concentration = 0.7 mM, IBU concentration = 10 mg/L), PMS concentration (b, Temperature = 25 °C, pH = 4.5, catalyst loading = 0.3 g/L, IBU concentration = 10 mg/L), pH value (c, Temperature = 25 °C, PMS concentration = 0.7 mM, catalyst loading = 0.3 g/L, IBU concentration = 10 mg/L) and temperature (d, pH = 4.5, PMS concentration = 0.7 mM, catalyst loading = 0.3 g/L, IBU concentration = 10 mg/L) on the degradation of ibuprofen respectively.

.

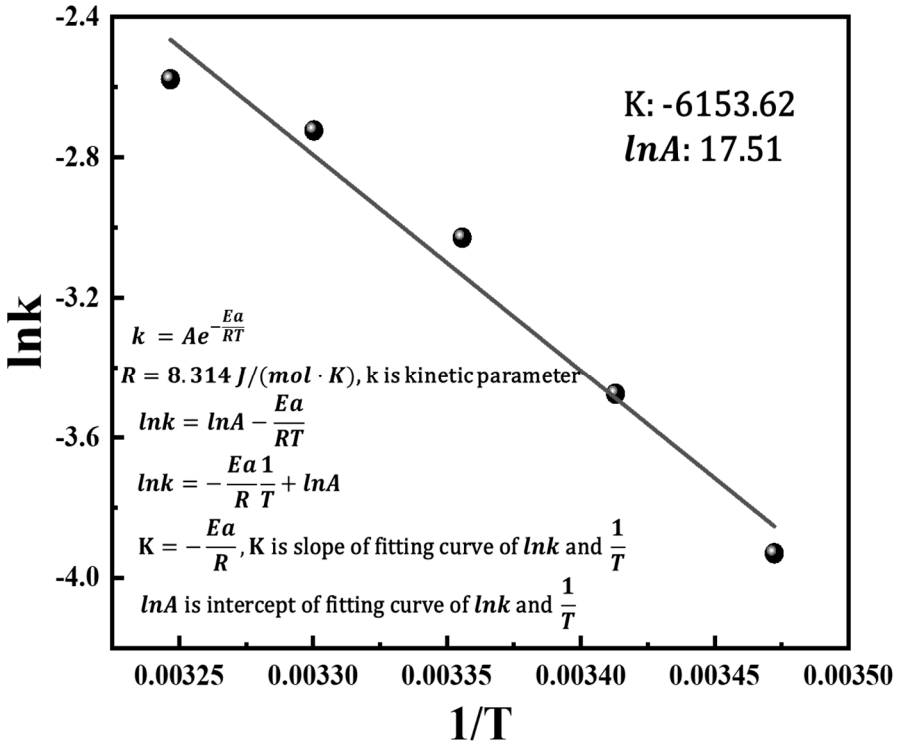



**Figure S6.** Linear fitting of the logarithmic value of kinetic constant (lnk) and the reciprocal of Kelvin temperature (1/T), (pH = 4.5, PMS concentration = 0.7 mM, catalyst loading = 0.3 g/L, IBU concentration = 10 mg/L).

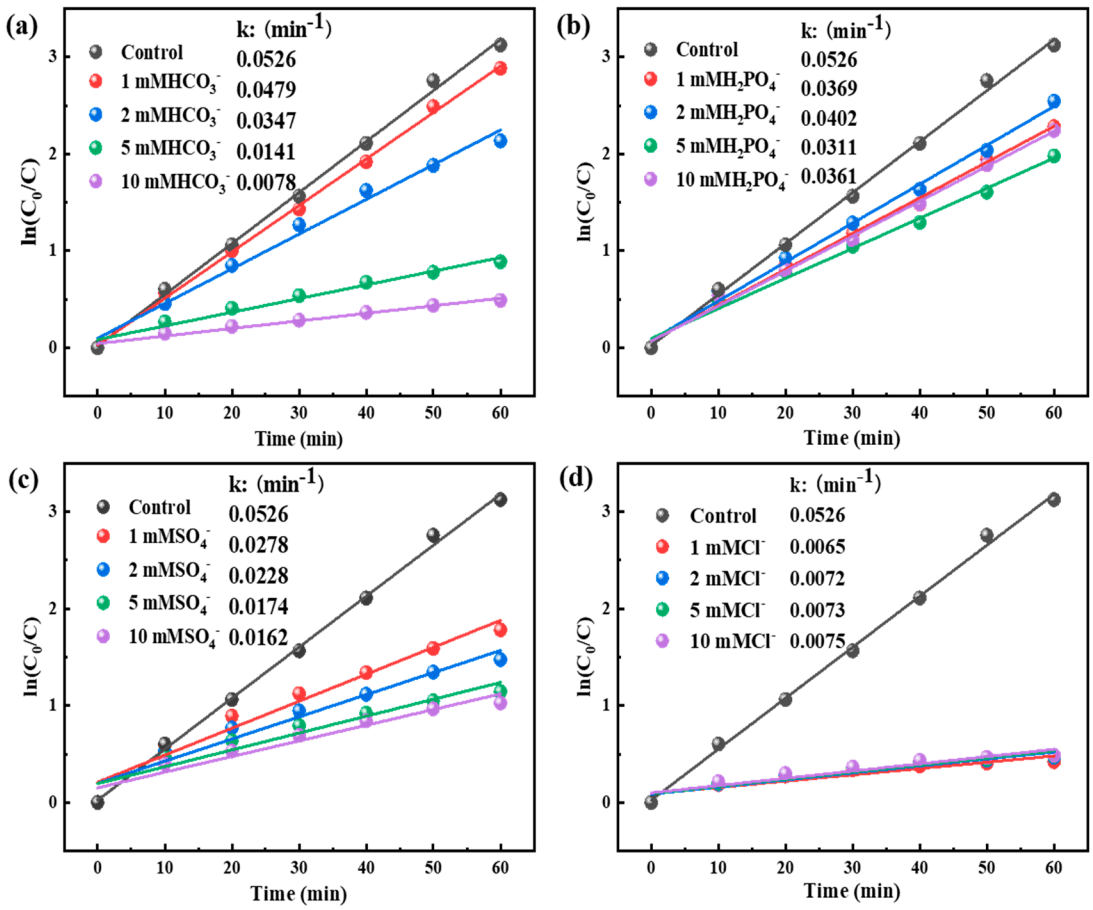



**Figure S7.** Kinetic fitting for the catalytic degradation of ibuprofen under different concentrations coexisting anion, $HCO_3^-$ (a), $H_2PO_4^-$ (b), $SO_4^{2-}$ (c), $Cl^-$ (d) on the degradation effect of ibuprofen respectively (Temperature = 25 °C, pH = 4.5, PMS concentration = 0.7 mM, catalyst loading = 0.3 g/L, IBU concentration = 10 mg/L).

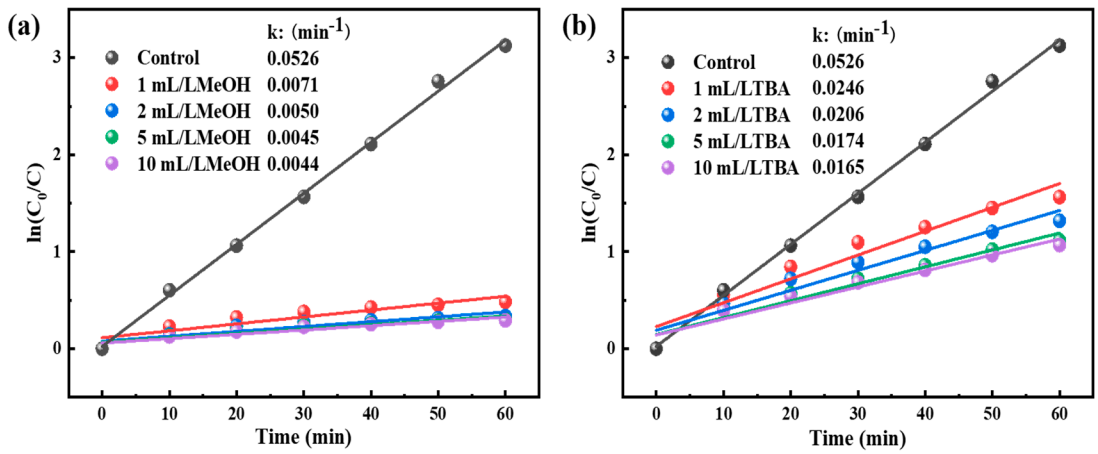



**Figure S8.** Kinetic fitting for the degradation of ibuprofen under different quenching environment, MeOH (a), TBA (b), (Temperature = 25 °C, pH = 4.5, PMS concentration = 0.7 mM, catalyst loading = 0.3 g/L, IBU concentration = 10 mg/L).

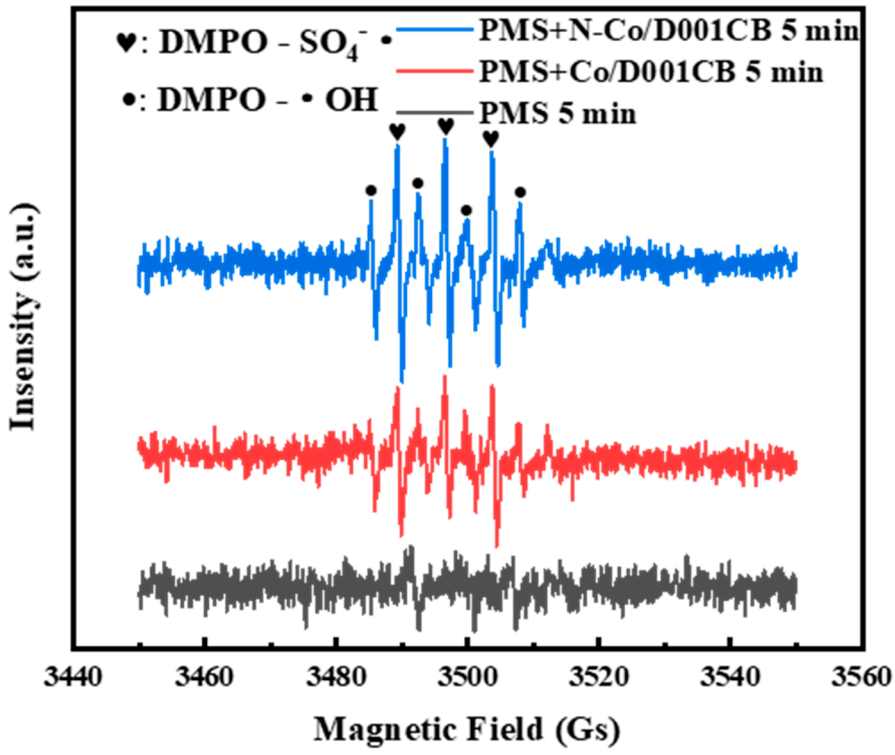



**Figure S9.** The EPR test with DMPO to detect $SO_4^{-}\cdot$ and $\cdot OH$.

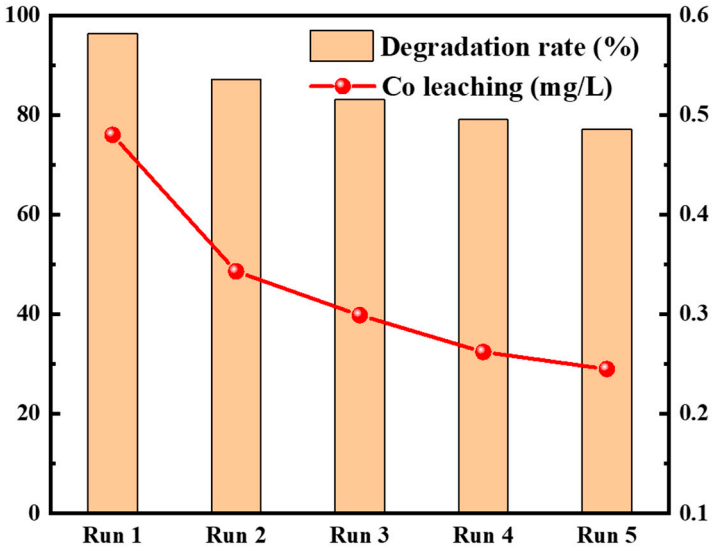



**Figure S10.** IBU degradation rates and cobalt ion leaching in the N-Co/D001CB in five runs (Temperature = 25 °C, pH = 4.5, PMS concentration = 0.7 mM, catalyst loading = 0.3 g/L, IBU concentration = 10 mg/L, recycled materials are both cleaned, dried and calcined).

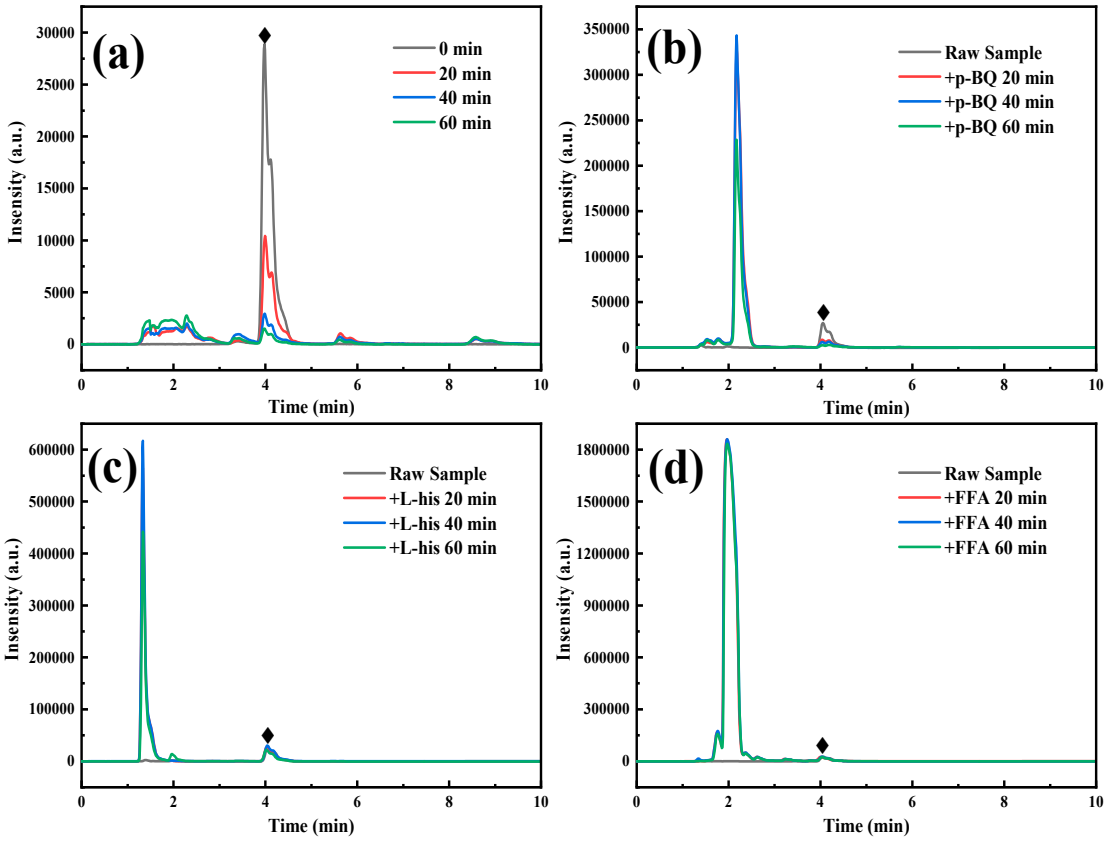



**Figure S11.** The Peak diagram of reaction liquid measured by HPLC in every 20min (a), and after added different quencher, 1 mmol/L p-BQ (b), 1 mmol/L L-his (c), 1 mL/L FFA (d), (Temperature = 25 °C, pH = 4.5, PMS concentration = 0.7 mM, catalyst loading = 0.3 g/L, IBU concentration = 10 mg/L).

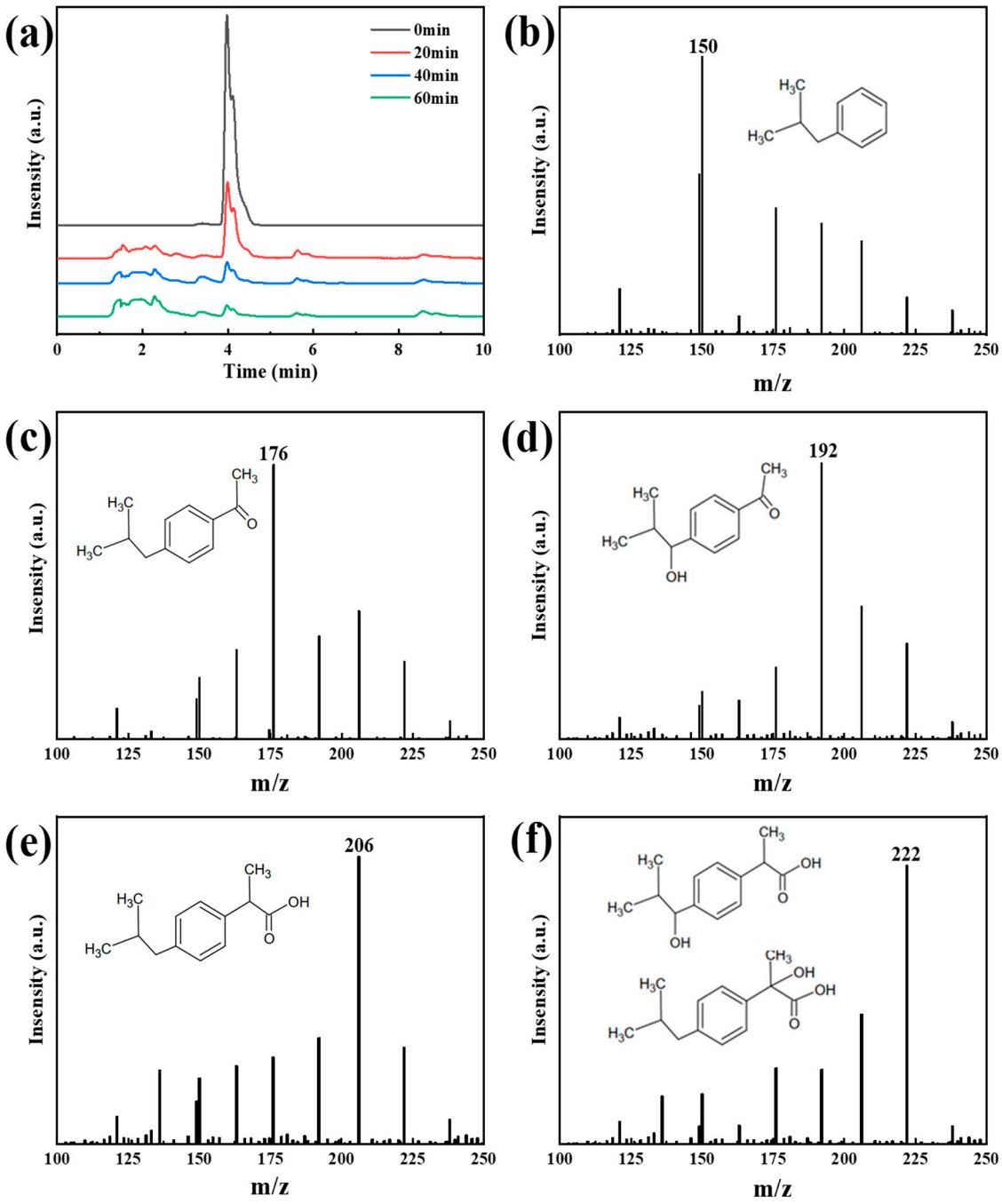



**Figure S12.** The Peak diagram of reaction liquid measured by HPLC (a), Liquid quality analysis map measured by LC-MS at the reaction time of 20 min (b-f).