

Supporting Information

Synthesis of activated porous carbon from red dragon fruit peel waste for highly active catalytic reduction of toxic organic dyes

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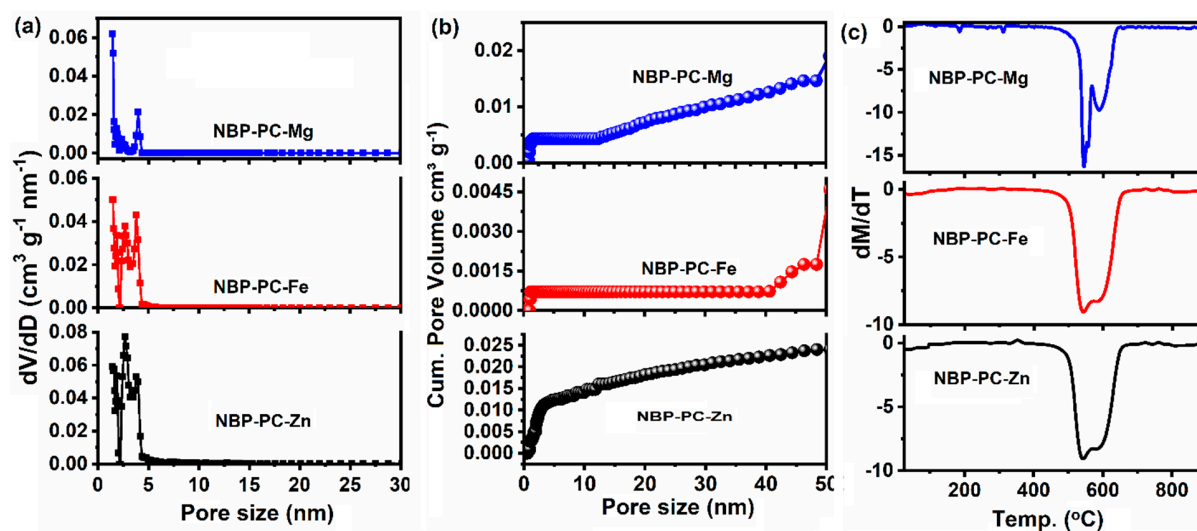


Figure S1. (a) Pore size distributions, (b) Pore size vs cumulative pore volume, and (c) DTA curves of NBP-PC-Mg, NBP-PC-Fe, and NBP-PC-Zn samples.

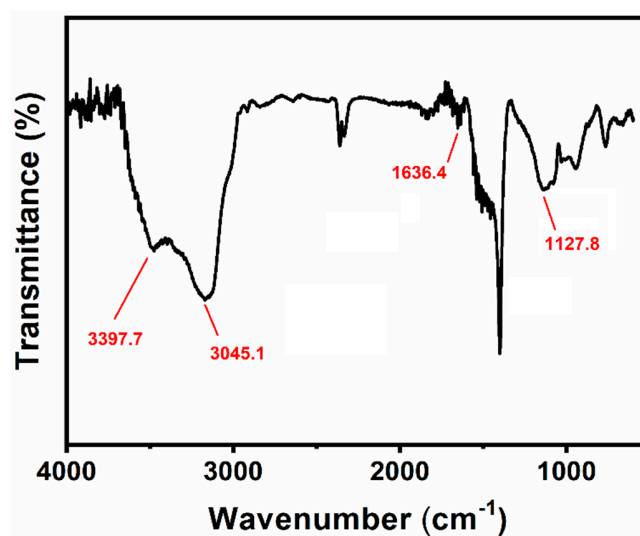


Figure S2. FT-IR spectrum of dry dragon fruit peels.

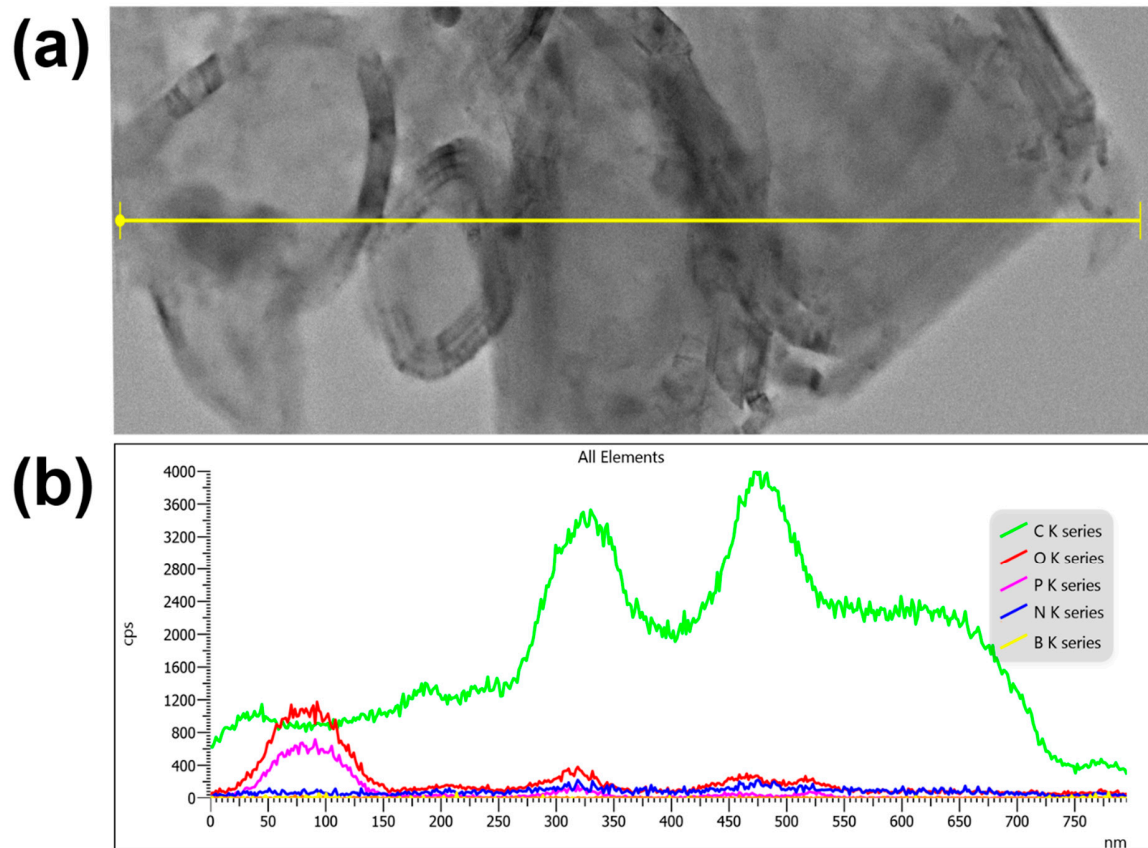


Figure S3. (a) The FE-TEM dark image indicating the EDS line scan position and (b) the spectrum of a representative elements.

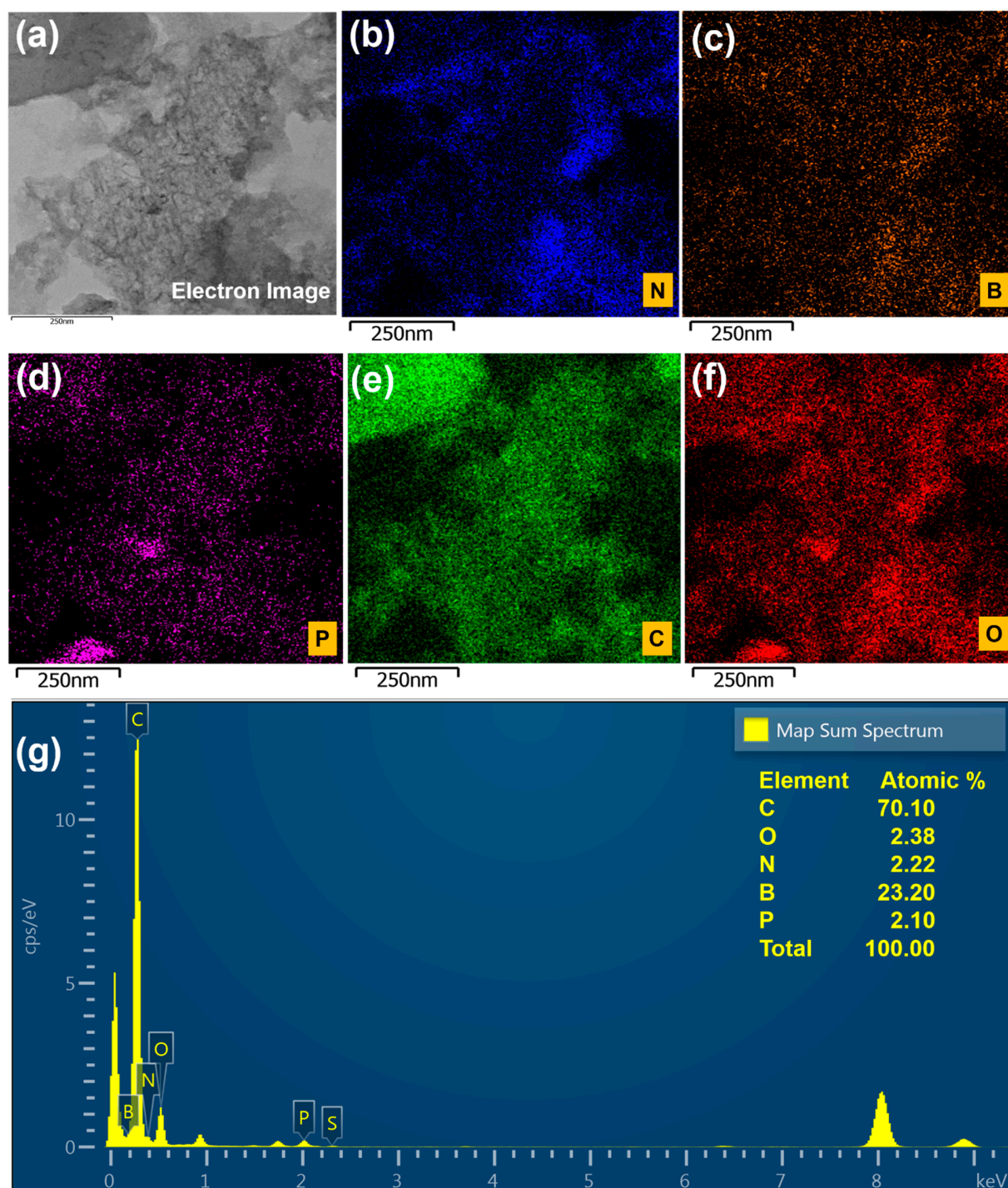


Figure S4 . (a) STEM image, (b–f) element mapping (N, B, P, C, and O elements), and (g) EDS results of NBP-PC-Mg sample.

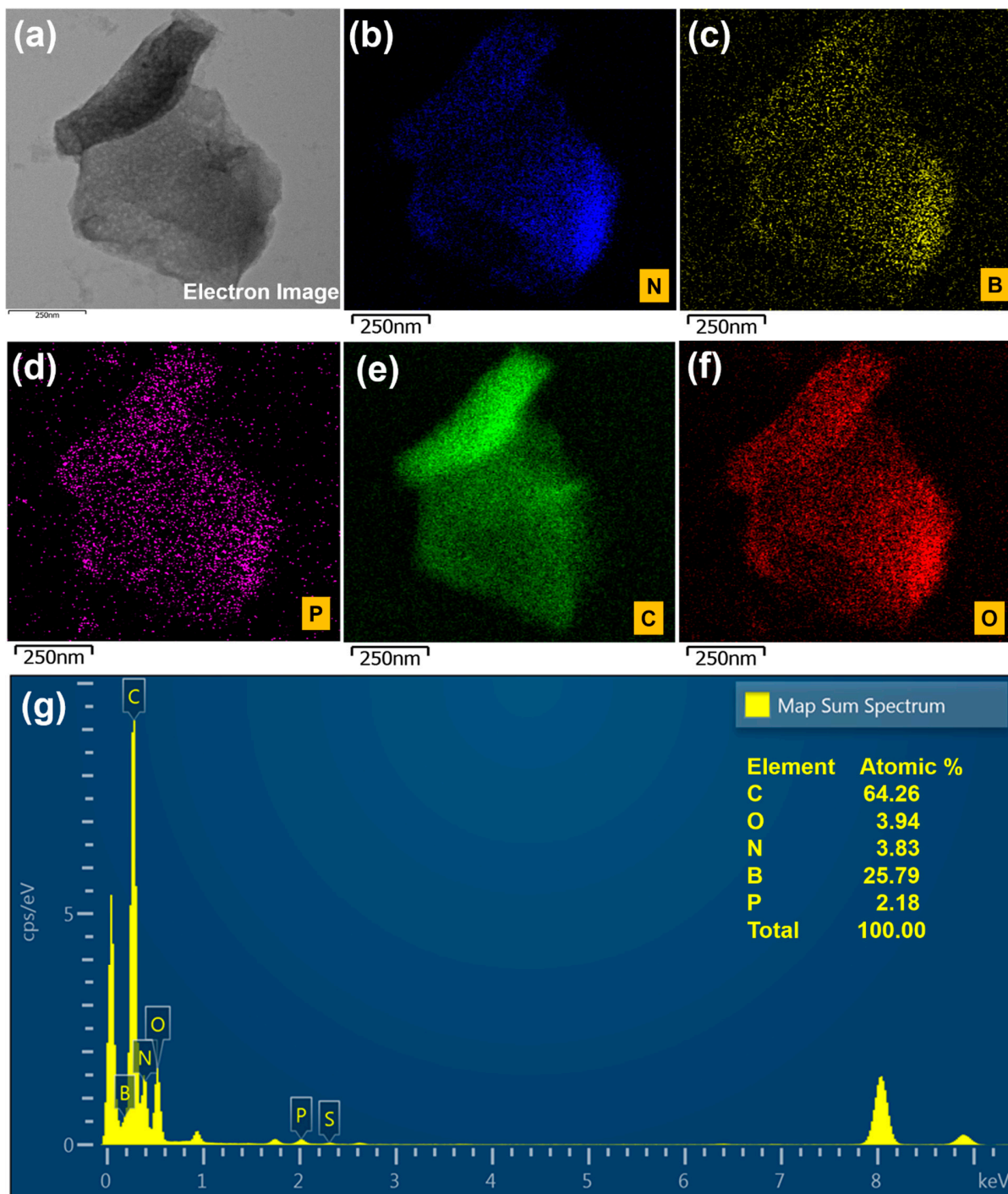


Figure S5. (a) STEM image, (b–f) element mapping (N, B, P, C, and O elements), and (g) EDS results of NBP-PC-Fe sample.

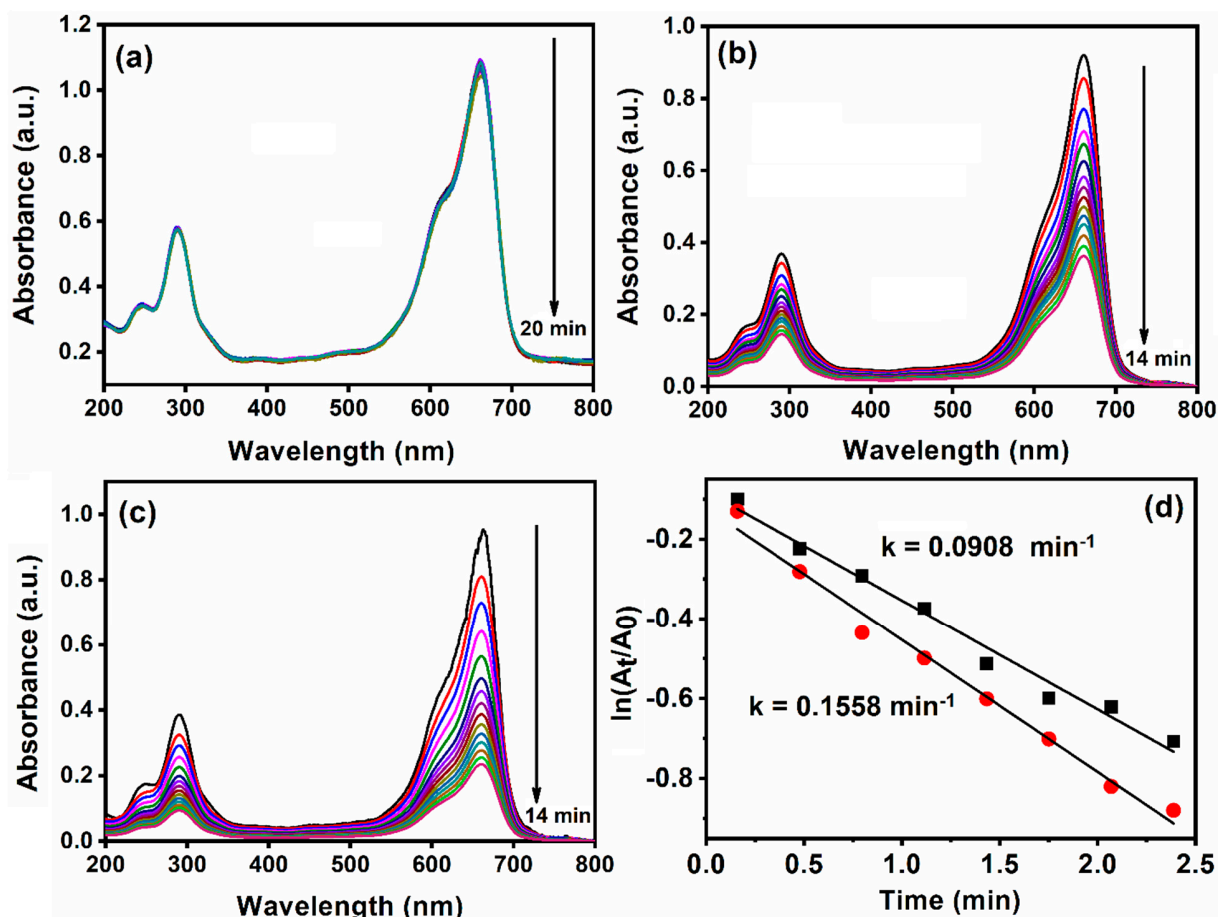


Figure S6. (a) Absence of NBP-PC-Zn catalyst, (b) presence of 0.2 mg, (c) presence of 0.4 mg of NBP-PC-Zn catalyst, and (b) the corresponding plot of $\ln(A_t/A_0)$ vs. time.

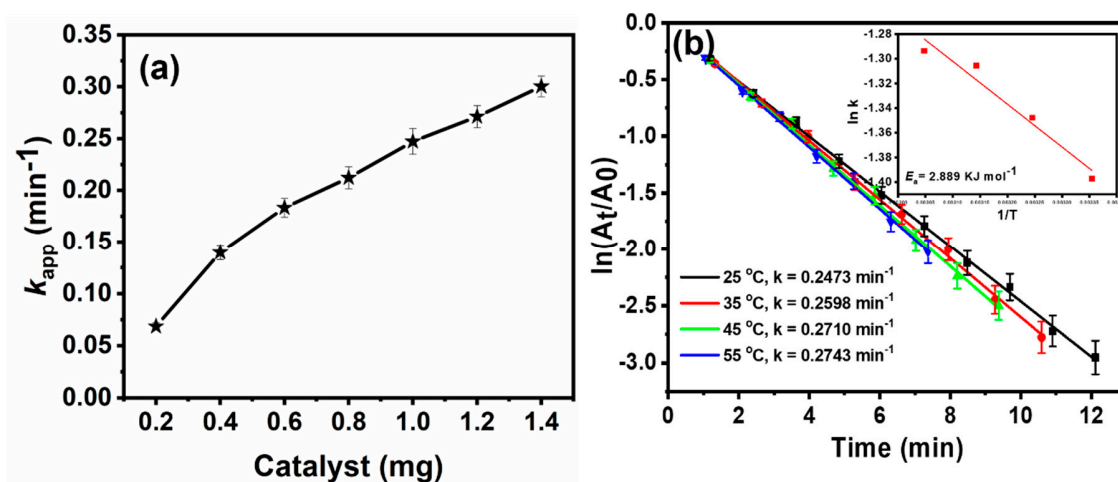


Figure S7. (a) The k_{app} for MB reduction of over different dosage of NBP-PC-Zn catalyst and (b) Kinetic curves of MB reduction expressed in the graph $\ln(A_t/A_0)$ vs. time (Insert: $\ln(k)$ vs. $1/T$).

Table S1. Chemical and physical characteristics of the organic dyes

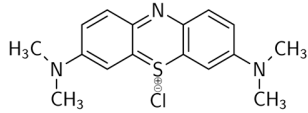
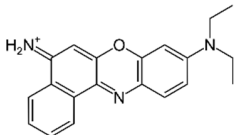
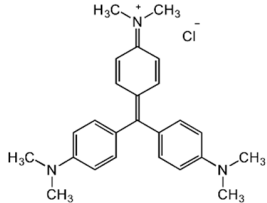
Characteristics	Value	Value	Value
Dye name	MB	NB	CV
Wavelength (λ_{max})	665	612	586
Molecular weight	319.85	353.845	407.979
Molecular formula	$C_{16}H_{18}N_3SCl$	$C_{20}H_{20}N_3OCl$	$C_{25}N_3H_{30}Cl$
Molecular structure			

Table S2. Summary of XPS data obtained from fitting calculations for the B.E values of each component and their respective assignments.

	NBP-PC-Mg			NBP-PC-Fe				NBP-PC-Zn				
assignment	B–C	BN/BC ₂ O	B–O	B–C	BN/BC ₂ O	<i>sp</i> ² C–B–N	B–O	B–C	BN/BC ₂ O	<i>sp</i> ² C–B–N	B–O	
s												
B.E (eV)	190.9 ± 0.02	191.8 ± 0.01	193.0 ± 0.02	187.1 ± 0.01	189.4 ± 0.02	191.5 ± 0.02	193.5 ± 0.02	187.1 ± 0.01	189.0 ± 0.03	191.2 ± 0.02	193.1 ± 0.01	
assignment	NBP-PC-Mg			NBP-PC-Fe				NBP-PC-Zn				
nmens	pyridinic-N	pyridinic-N	pyrrolic-N	pyridinic-N	pyrrolic-N	pyridinic-N	pyrrolic-N	quaternary-N	N-oxide			
B.E (eV)	398.5 ± 0.02	398.5 ± 0.02	400.1 ± 0.01	398.4 ± 0.02	399.0 ± 0.01	398.2 ± 0.02	400.0 ± 0.01	402.1 ± 0.01		402.9 ± 0.01		
assignment	NBP-PC-Mg			NBP-PC-Fe				NBP-PC-Zn				
s	C–P–O	C–P–O	C–P–O	C–P–O	C–P–O	C–P–O	C–P–O	C–P–O	C–P–O	C–P–O	C–P–O	
B.E (eV)	133.5 ± 0.02	134.4 ± 0.01		133.6 ± 0.03	134.5 ± 0.02		134.3 ± 0.02		135.4 ± 0.01			
assignment	NBP-PC-Mg			NBP-PC-Fe				NBP-PC-Zn				
s	<i>sp</i> ² C=C	<i>sp</i> ³ C–C	C–N/ C=N	O–C=O	<i>sp</i> ² C=C	<i>sp</i> ³ C–C	C–N/ C=N	O–C=O	<i>sp</i> ² C=C	<i>sp</i> ³ C–C	C–N/ C=N	O–C=O
B.E (eV)	284.1 ± 0.01	285.8 ± 0.02	287.3 ± 0.03	290.2 ± 0.01	284.4 ± 0.01	285.7 ± 0.02	289.0 ± 0.01	289.4 ± 0.02	285.0 ± 0.02	285.2 ± 0.03	286.8 ± 0.01	289.1 ± 0.01
	NBP-PC-Mg			NBP-PC-Fe				NBP-PC-Zn				

assignment	C=O	C=O	C–O	C=O	C–O
s					
B.E (eV)	529.9 ± 0.01	530.1 ± 0.01	533.5 ± 0.01	531.6 ± 0.01	533.0 ± 0.02 eV