

Supplementary Information

Pyrolyzed biosolid surface features promote a highly efficient oxygen reduction reaction

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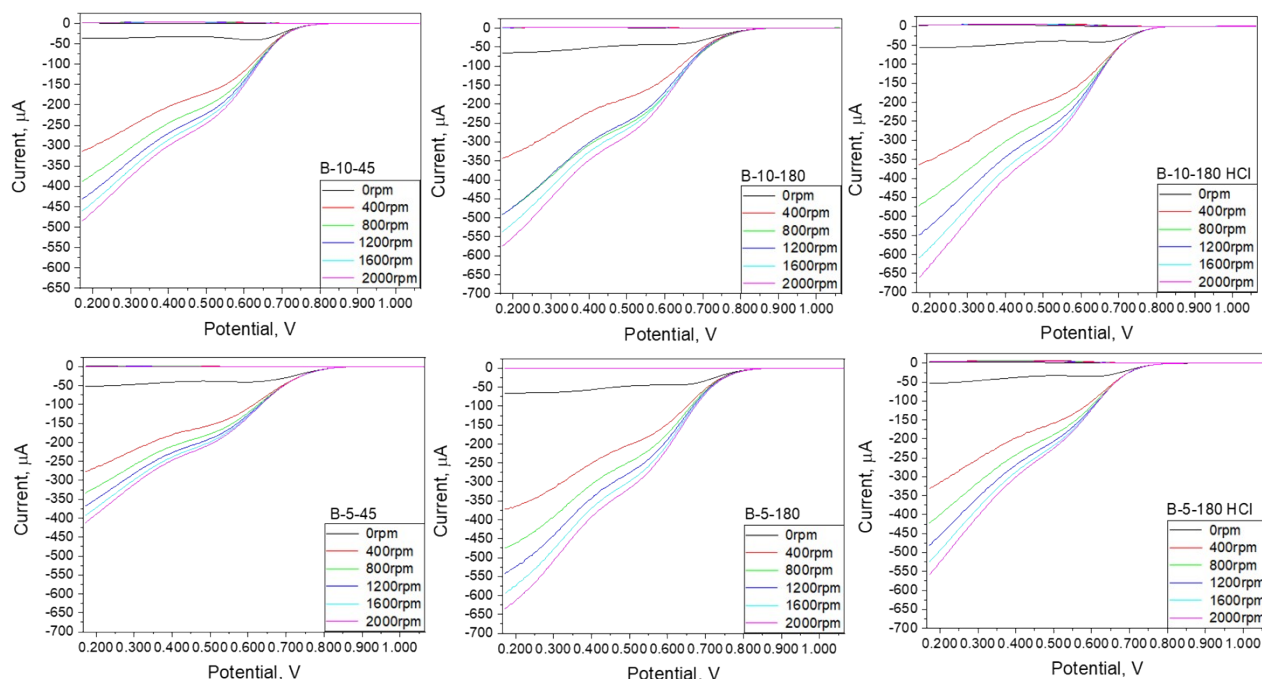


Figure S1. LSV curves of the samples tested.

Table S1. The detailed results B-10-45. The content of elements (ICP-OES) is in ppm.

Sample	B-10-45
% Moisture	3.21
% LOI	21.11
Al	41317
Ba	1223
Ca	51274
Co	27
Cr	132
Cu	1898
Fe	58042
K	6977
Mg	18566
Mn	1964
Mo	117
Na	9520
Ni	85
Pb	16
Si	76698
Ti	7673
V	66
Zn	1583

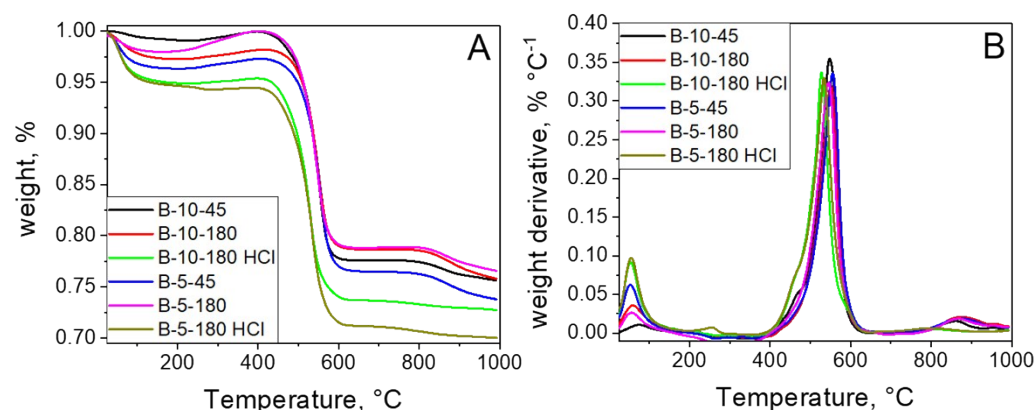


Figure S2. A) TG and B) DTG curves in air for all samples tested.

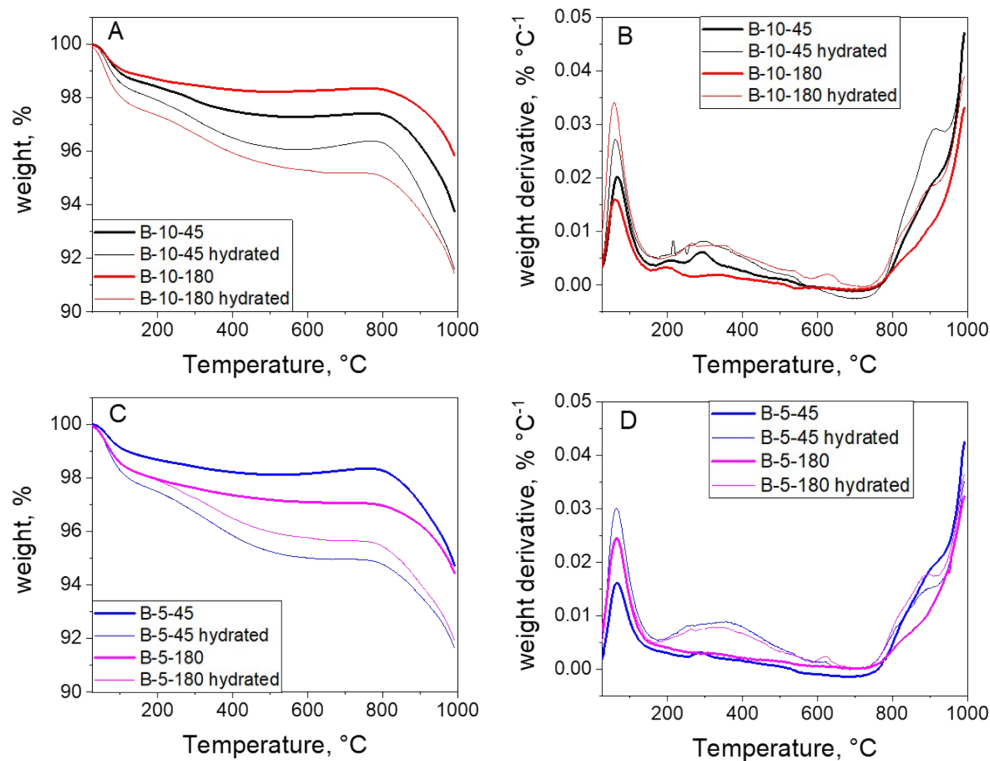


Figure S3. (A, B) TG-DTG curves in air for B-10-45 and B-10-180 dry and after soaking in water for three hours; (C, D) TG-DTG curves in argon for B-5-45 and B-5-180 dry and after soaking in water for three hours

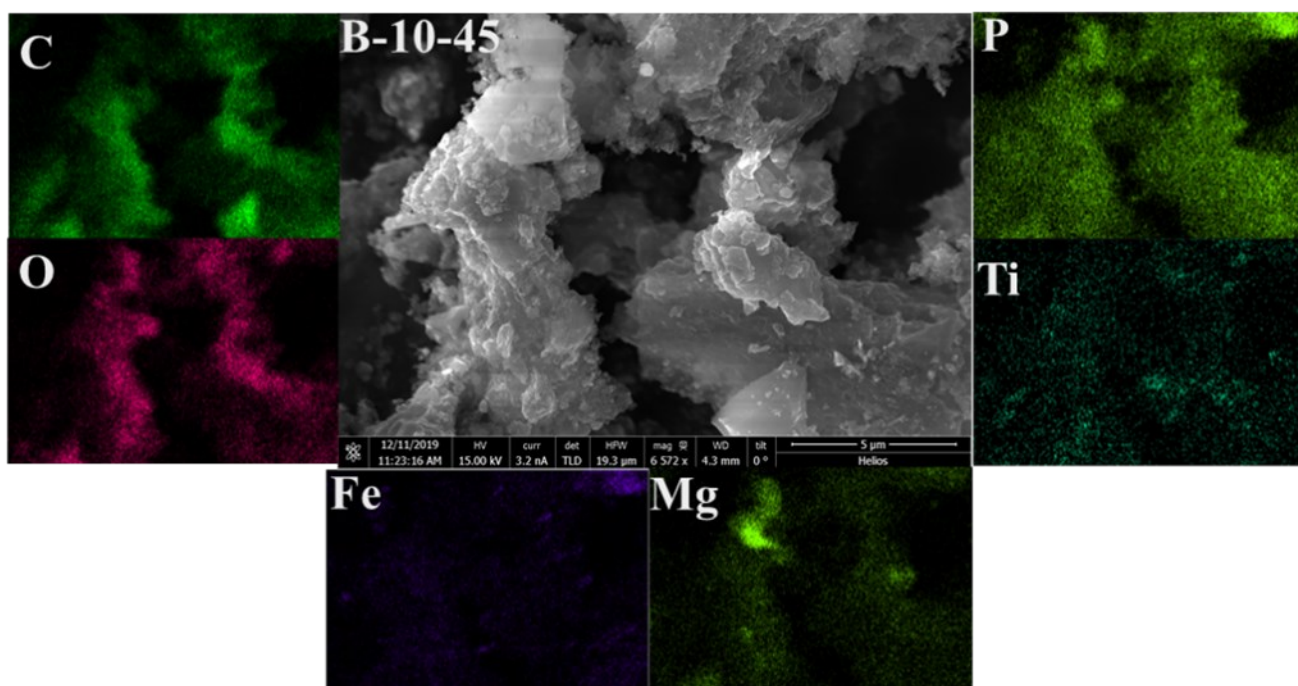


Fig S4. SEM images of B-10-45 and the corresponding element mapping of C, O, Fe, Mg; P and Ti.

Table S2. Elements detected by SEM-EDS analysis in B-10-45

Element [% wt.]	B-10-45
C	54.1
O	16.8
Fe	6.8
Ca	5.9
Si	3.0
P	5.8
Mg	1.5
S	1.6
Ti	0.6
Cu	0.2
Al	2.8
K	0.5
Na	0.3
Mn	0.2
Cl	0.1

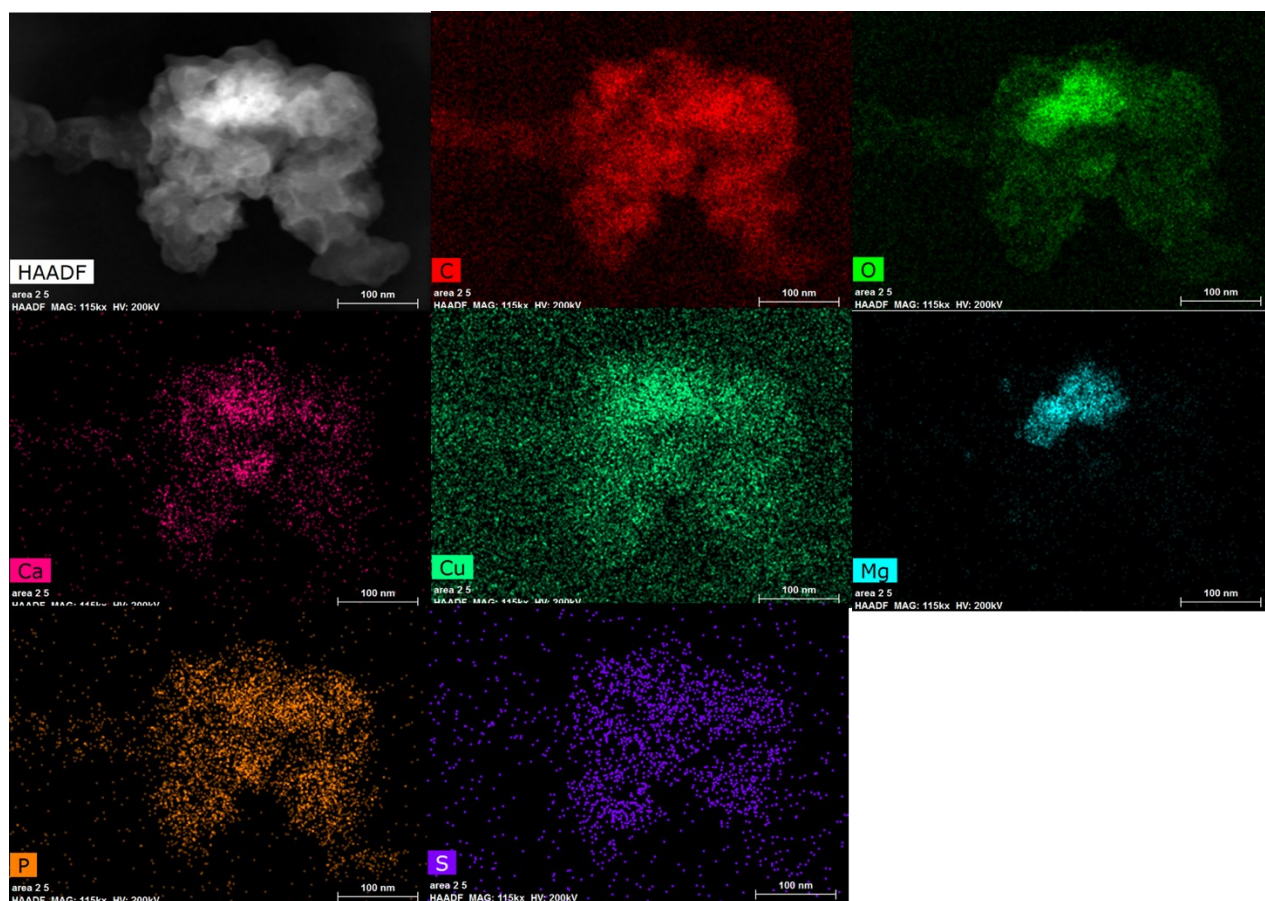


Figure S5. TEM image of B-10-180 and the corresponding element mapping of C, O, Ca, Cu, Mg, P, and S.

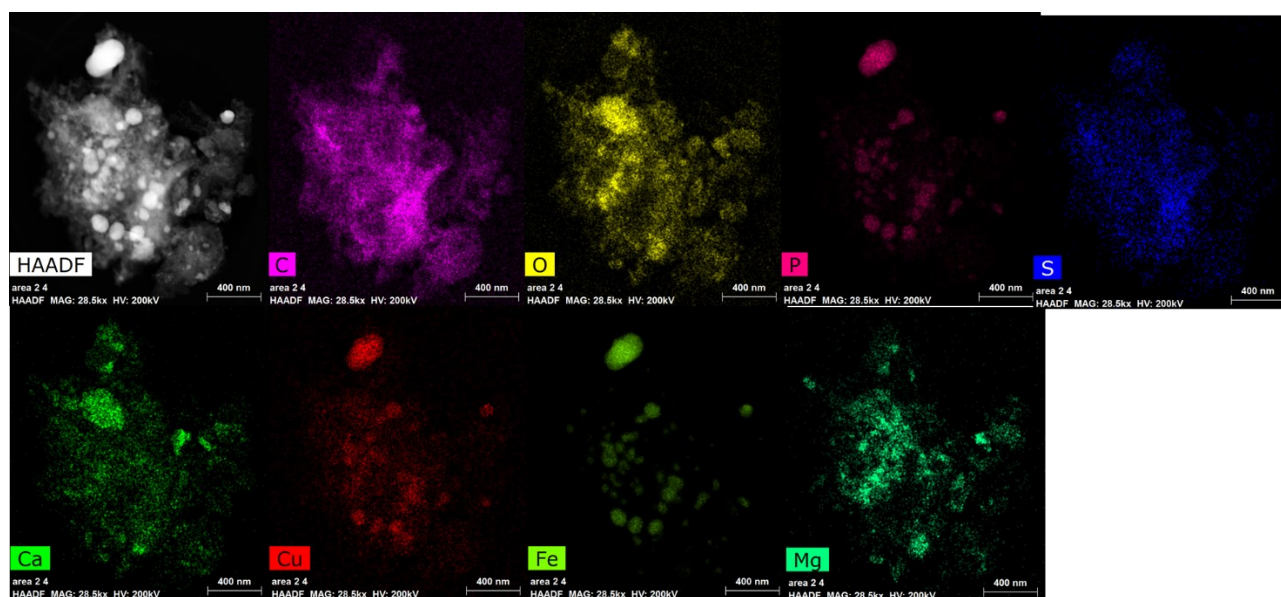


Figure S6. TEM image of B-5-180 and the corresponding element mapping of C, O, P, S, Ca, Cu, Fe and Mg.

Table S3. Element detected by TEM-EDS analyses

Element [% wt.]	B-10-180	B-5-180
C	62.4	56.2
O	14.5	10.9
Fe	0.3	10.5
Ca	1.0	2.2
Si	6.6	3.6
P	1.2	3.9
Mg	1.7	1.3
S	0.3	0.9
Cu	7.2	5.5

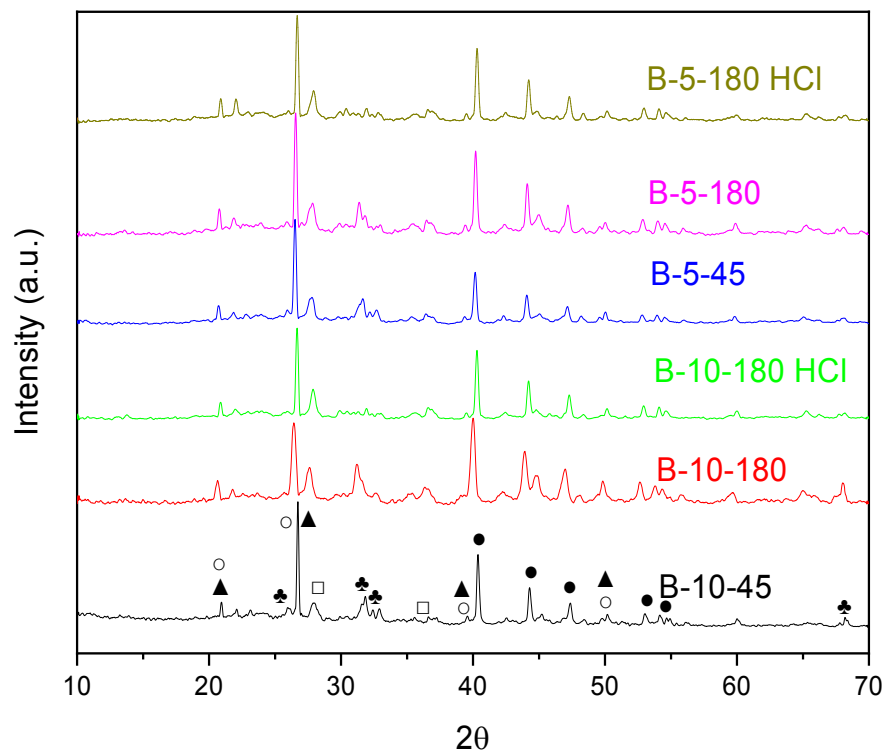


Figure S7. XRD patterns of the investigated samples. ●Fe₂P (barringerite), ▲SiO₂ (quartz), ○AlPO₄ * aluminum phosphate), ♣Ca₁₀(PO₄)₆(OH,Cl)₂ (apatite) □ CaAl₂Si₂O₈ (anorthite).

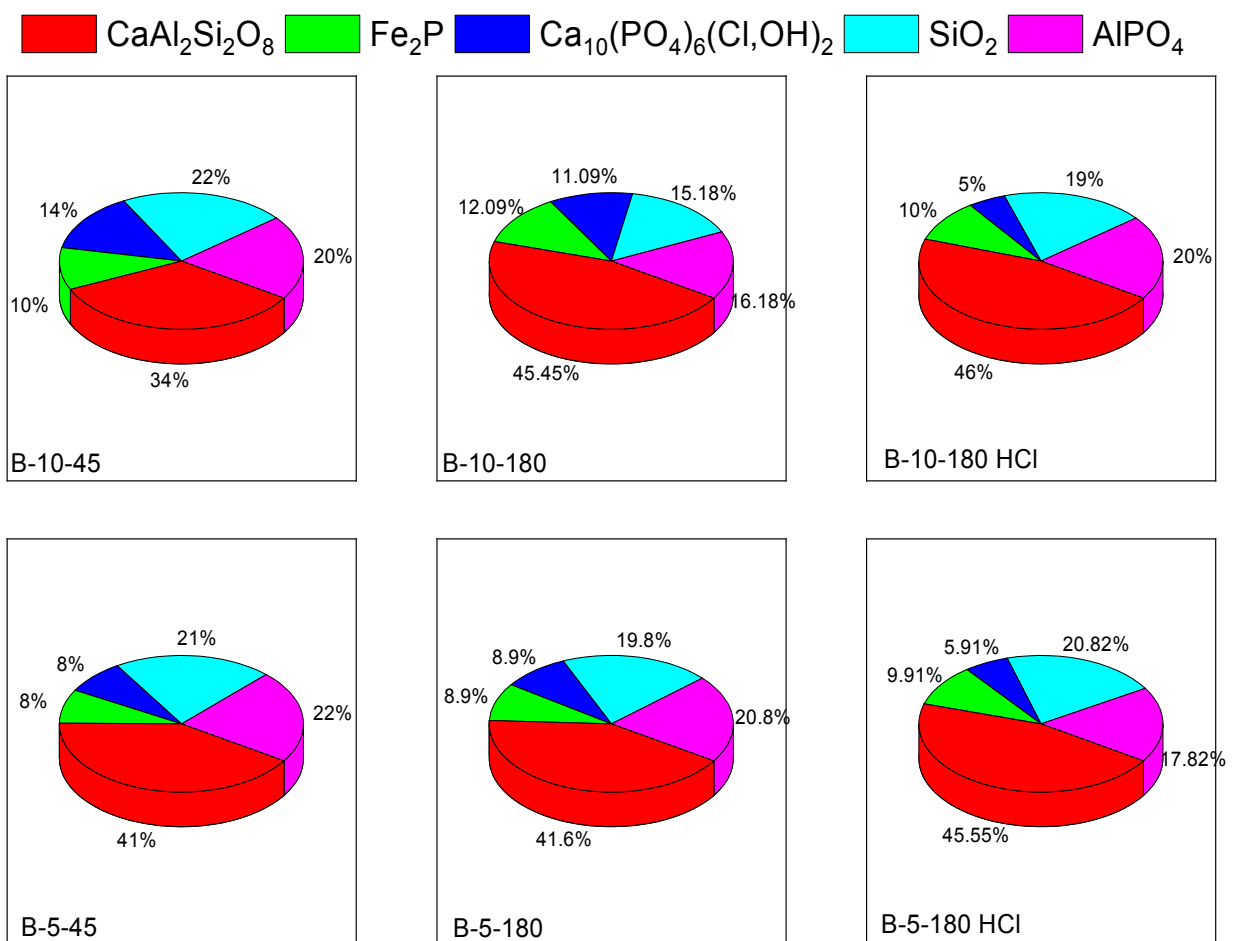


Figure S8. Quantification of the crystalline phases in the samples. ($\text{CaAl}_2\text{Si}_2\text{O}_8$ - anorthite; quartz (SiO_2 - quartz; Fe_2P - barringerite; $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH},\text{Cl})_2$ - apatite; $\text{Al}(\text{PO})_4$ - aluminum phosphate).

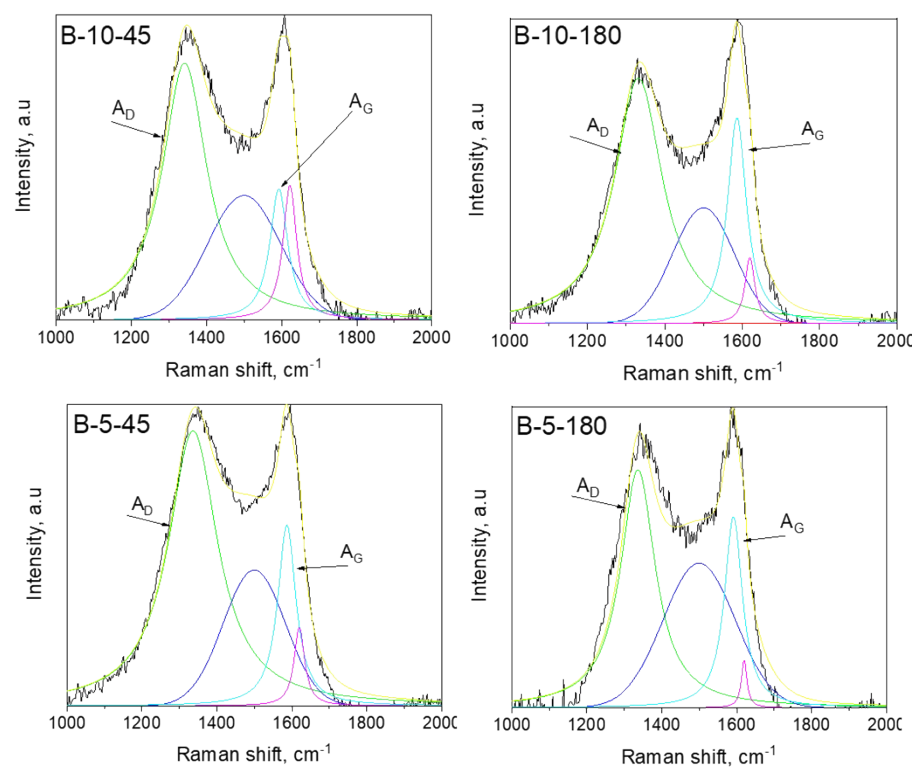


Figure S9. Raman spectra of the samples tested.

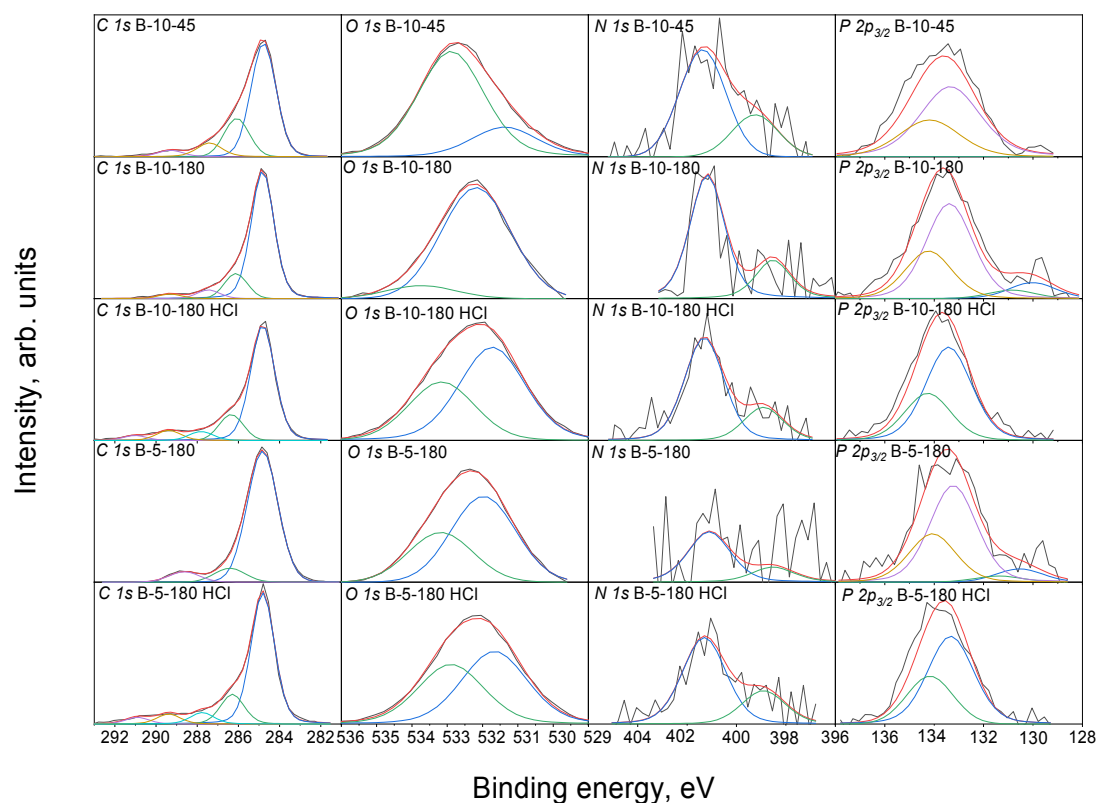


Figure S10. Deconvolutions of C 1s, O 1s, N 1s and P 2p_{3/2} core energy level spectra.

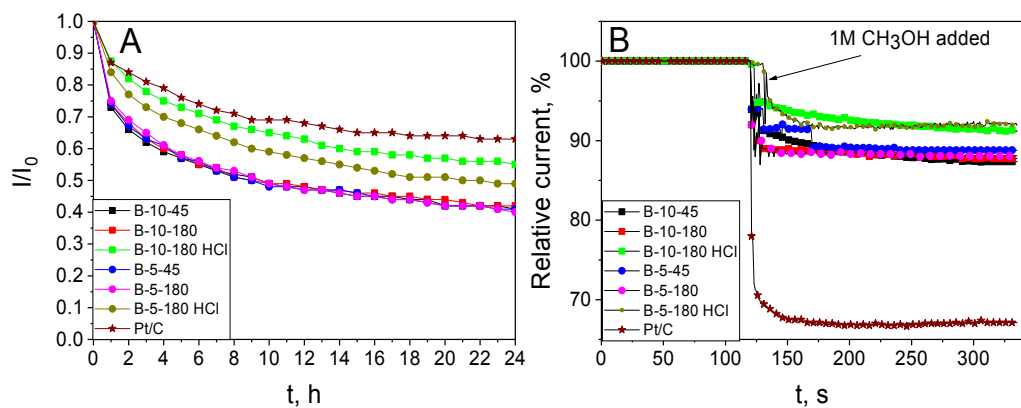


Figure S11. Stability of the catalysts (A) and Methanol tolerance (B).