

Supplementary Materials for

Bias Enhanced Electro- Photocatalysis on TiO₂ Nanoporous Materials for Decomposition of Forever Chemicals in Saltwater

*Sapanbir S. Thind,^{a,b} Bobby A. Ryane,^a John. B. Hayden,^b Ian Chagunda,^a Mathias Paul,^a J. Scott McIndoe^{*a}*

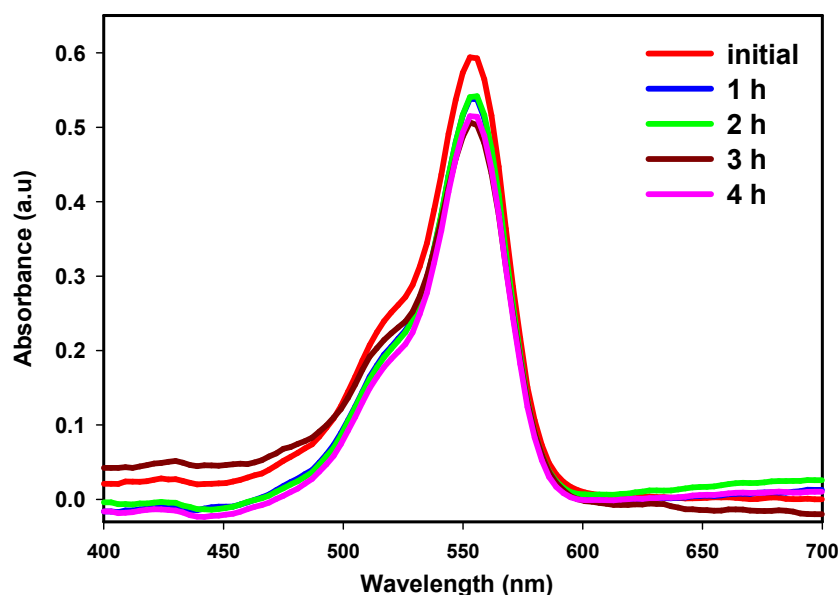


Fig. S1.

Scanning kinetic curves for the electrochemical oxidation of Rhodamine B in distilled water on TiO₂ nanoporous material at 2 V.

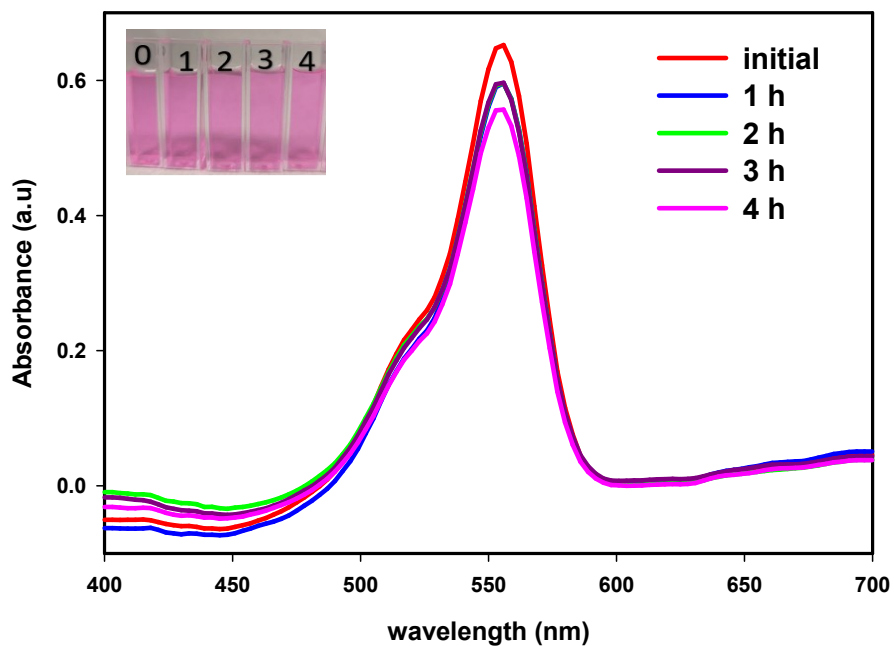


Fig. S2.

Scanning kinetic curves for electrochemical oxidation of Rhodamine B in 35000 ppm saltwater on TiO₂ nanoporous material at 2 V. (inset is the colour change during the process).

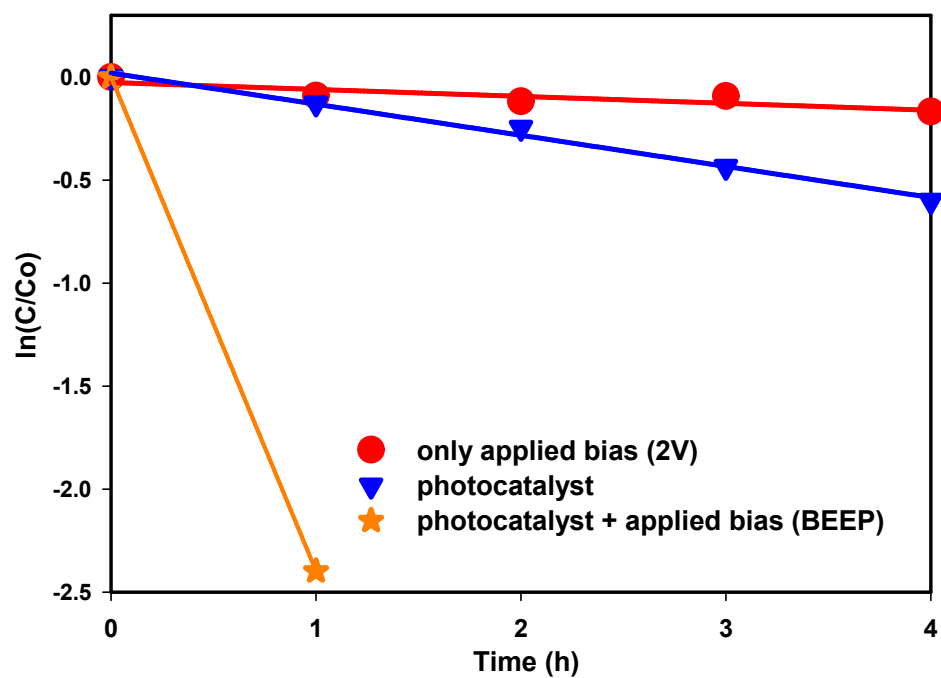


Fig. S3.

The relationship between $\ln(C/C_0)$ and time for the RhB degradation during the photo-, electrochemical and BEEP in 35000 ppm saltwater on TiO_2 nanoporous material.

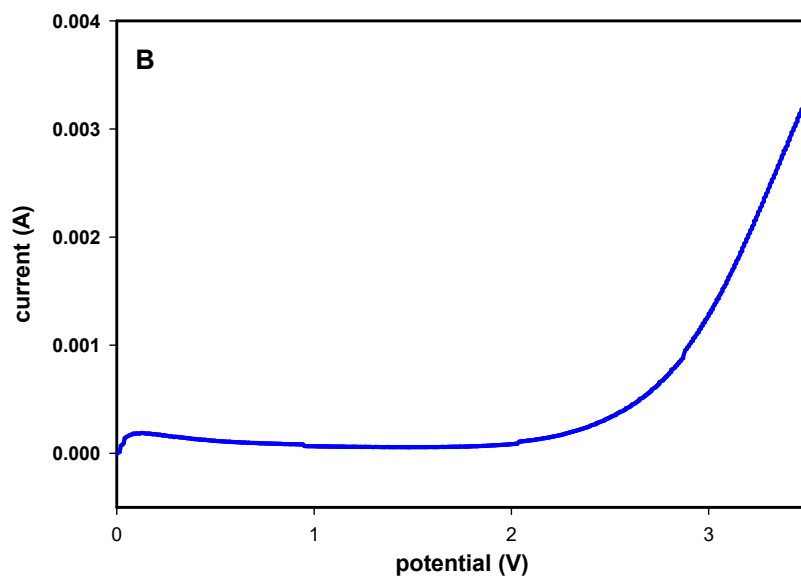
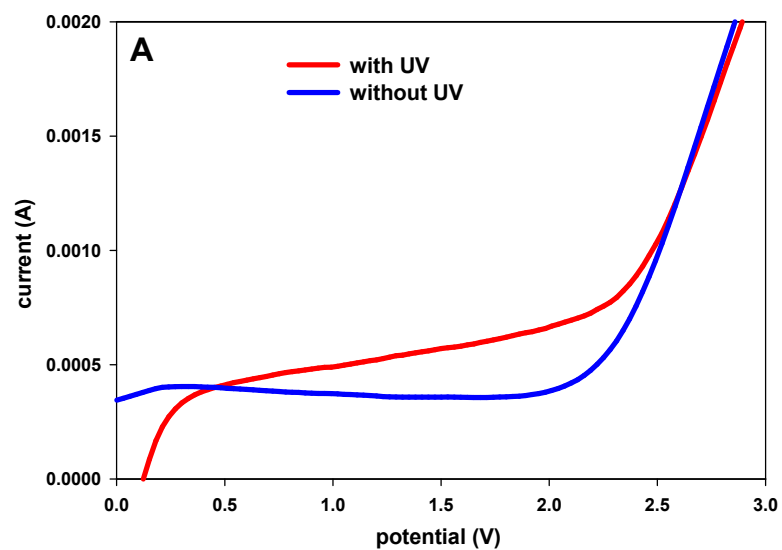


Fig. S4.

(A) Linear Sweep Voltammograms for BEEP in 0ppm salt solution with UVA (red) and without UVA (blue). (B) LSV for BEEP in 35000 ppm salt concentrations.

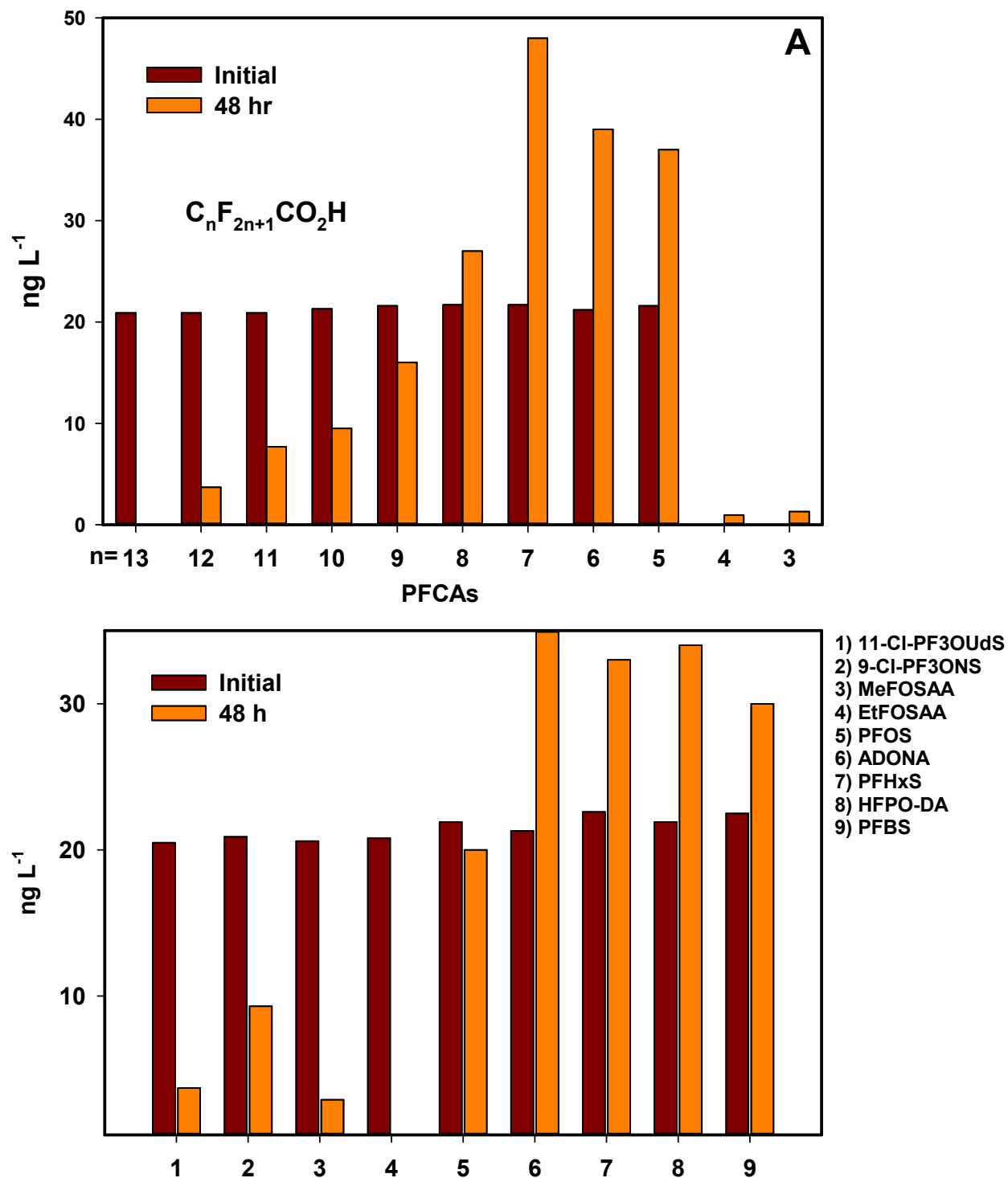
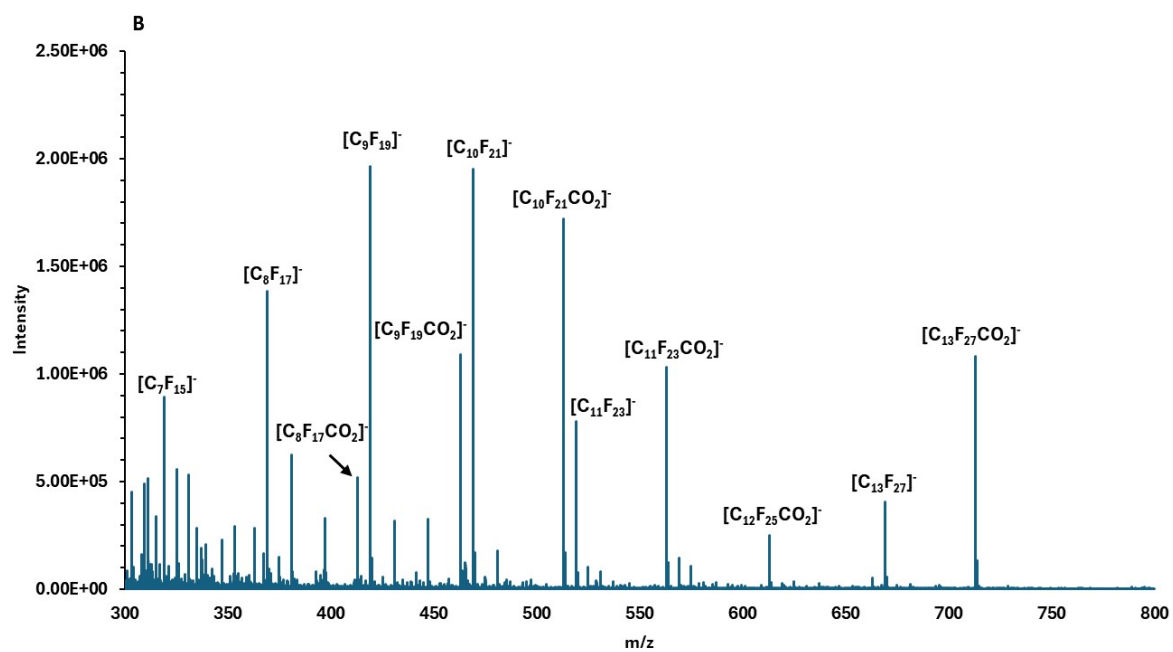
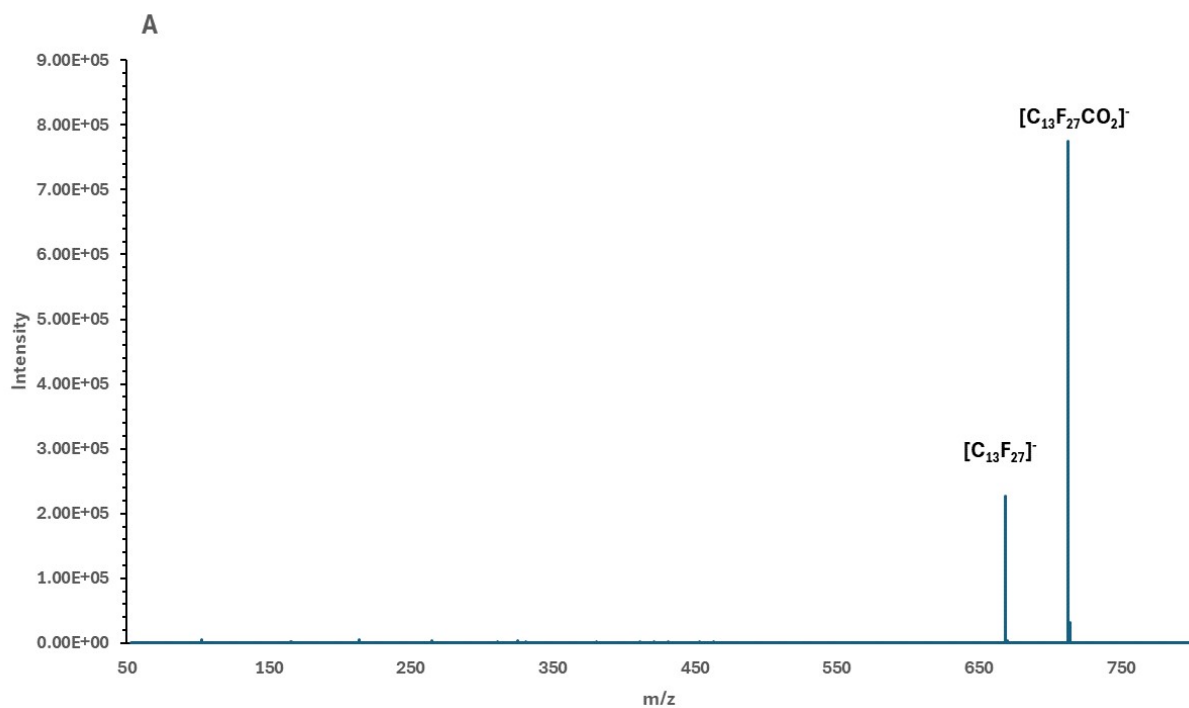


Fig. S5.

EPA 537.1 M testing with 18 analytes. Effect of BEEP photocatalytic oxidation on the concentration of (A) PFCA, (B) PFSA and various other PFAS.



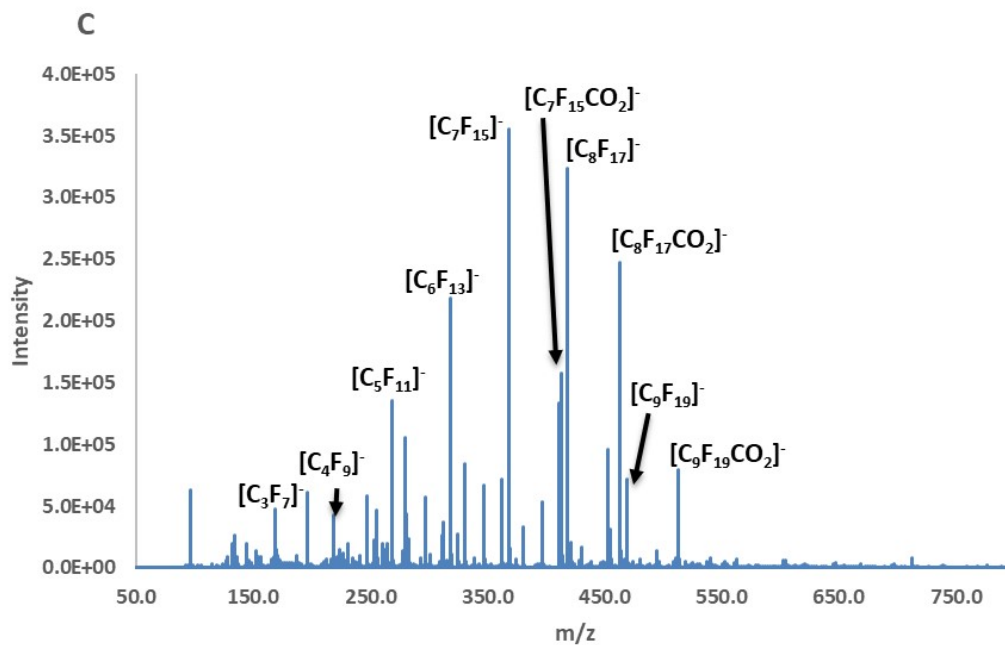


Fig. S6

MS spectra for PFTeDA (A) initial concentration, (B) after 24-hour oxidation, (C) after 96-hour oxidation.

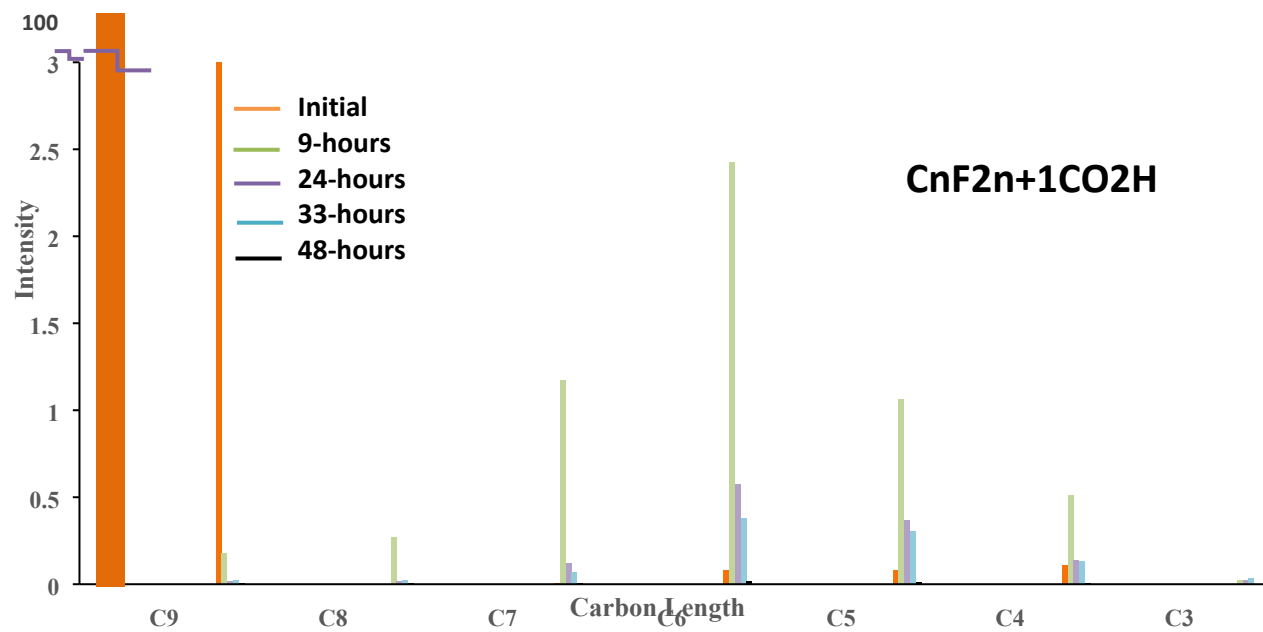


Fig. S7
Intensity of PFNA and resulting smaller chain PFAS from 0-hour to 48-hour.

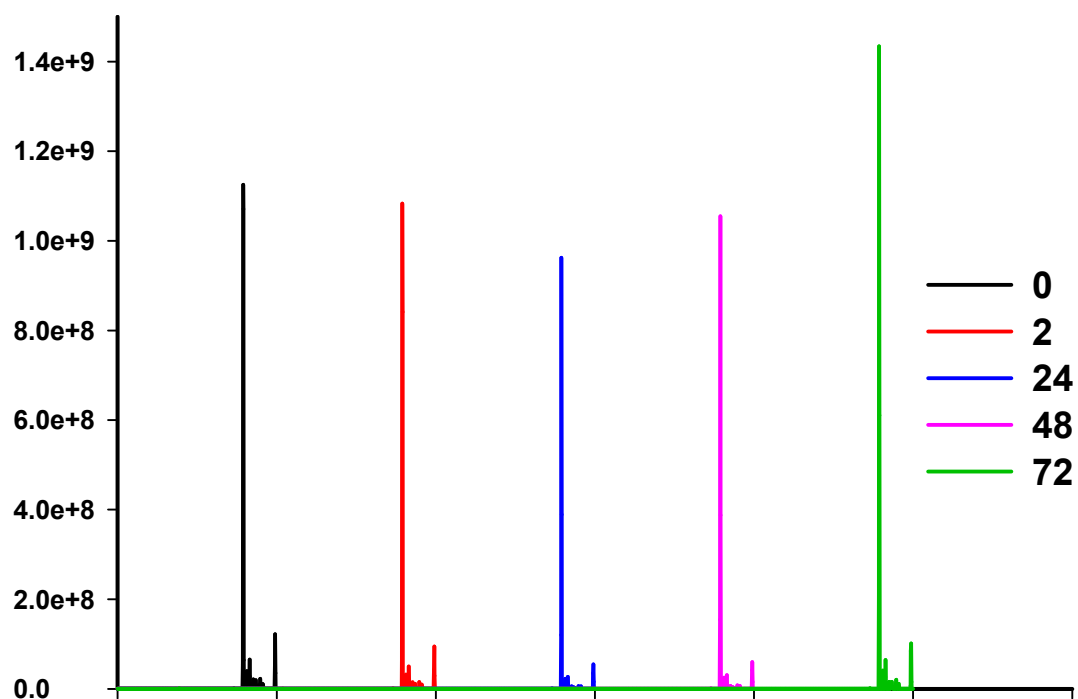


Fig. S8

Intensity of starting molecular peaks for the PFOS during the 72-hour experiment in 100 ppm saline solution. (m/z 498.942)

Applied Voltage (V)	Current when UVA off	Current when UVA on
0	-0.010 mA	0.3 mA
0.5	0.003 mA	0.9 mA
1	0.004 mA	1.9 mA
1.5	0.004 mA	3.9 mA
2	0.010 mA	5.2 mA
2.5	0.020 mA	6.5 mA
3	0.050 mA	7.6 mA
4	0.180 mA	10.1 mA
5	0.740 mA	12.27 mA

Table S1.

Different currents and photocurrents observed with a multimeter when different applied voltages were applied to BEEP in 3500 ppm salt solution (brackish water salinity level).

Applied Voltage (V)	Current when UVA off	Current when UVA on
0	-0.012 mA	0.6 mA
0.5	0.002 mA	4.4 mA
1	0.002 mA	7.5 mA
1.5	0.002 mA	12.2 mA
2	0.008 mA	17.8 mA
2.5	0.031 mA	24.5 mA
3	0.070 mA	31.5 mA
4	0.390 mA	44.0 mA
5	1.34 mA	57.0 mA

Table S2.

Different currents and photocurrents observed with a multimeter when different applied voltages were applied to BEEP in 35000 ppm salt solution (seawater salinity level).

Reference	This study	Park et al., 2018 ¹
Detail	Value (kWh)	Value (kWh)

Light source	0.0214	0.024
Mixing method	0.00948	2.6
External Bias energy	0.00040	0.0008
Total energy consumption	0.031	2.63

Table S3.

Comparison of total energy consumption of this study “BEEP” system (pH 6.0, volume: 2L, bias: 2.0V, temp: 25°C) with another traditional photoelectrocatalytic system (pH 3.0, volume: 2L, bias: 2.0V, temp: 25°C).

In the BEEP system, the voltage and current for Light Source was 12 V and 1.78 A respectively.

For the mixing method (pump), it was 12 V and 0.79 A current

For applied bias when 2V was applied, 0.2 mA current was recorded.