

DECOMPOSITION OF PERFLUOROCTANOIC ACID PHOTOCATALYZED BY TiO₂: CHEMICAL MODIFICATION OF THE CATALYST SURFACE INDUCED BY FLUORIDE IONS



M. Sansotera^{1,2,3}, S. Gatto^{*1,3}, F. Persico^{*2,3}, C. Pirola^{1,3}, W. Navarrini^{2,3}, C. L. Bianchi^{1,3}

¹ Università degli Studi di Milano, Dipartimento di Chimica, via Golgi, 19 – 20133 Milano (Italy)

² Politecnico di Milano, Dipartimento di Chimica, Chimica Industriale e Ingegneria Chimica "Giulio Natta", via Mancinelli, 7 – 20131 Milano (Italy)

³ Consorzio INSTM, via G. Giusti, 9 – 50121 Firenze (Italy)



(*) corresponding authors: sara.gatto@unimi.it fpersico@chem.polimi.it

PERFLUOROCTANOIC ACID

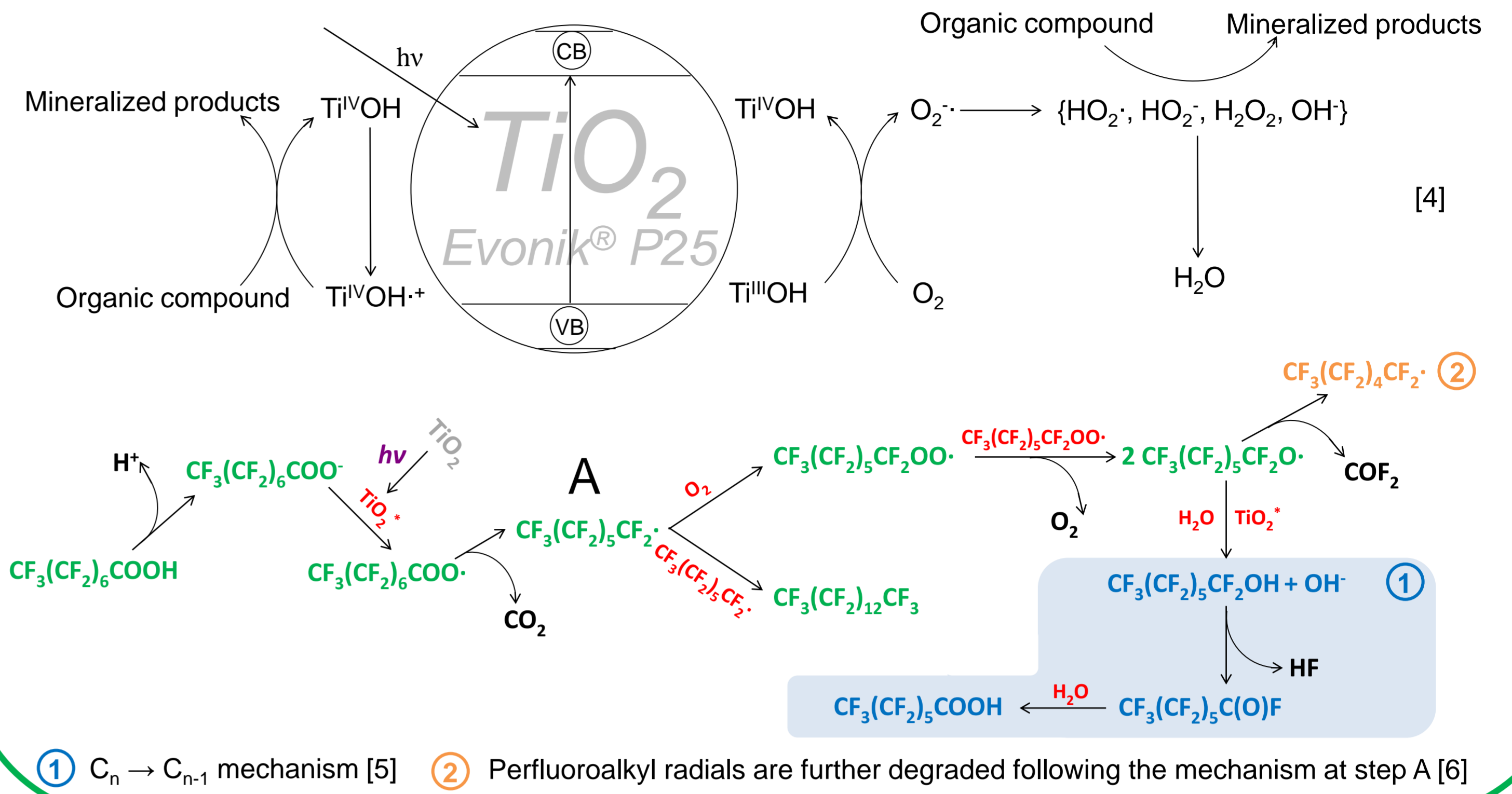
Perfluorooctanoic acid (PFOA) is one of the most largely employed industrial surfactant [1]. Recent studies have shown the presence of high levels of this compound in the environment, particularly in seas and rivers.

PFOA has been found to be bioaccumulative, carcinogen, liver and immune system toxicant and able to exert hormonal effects [2].

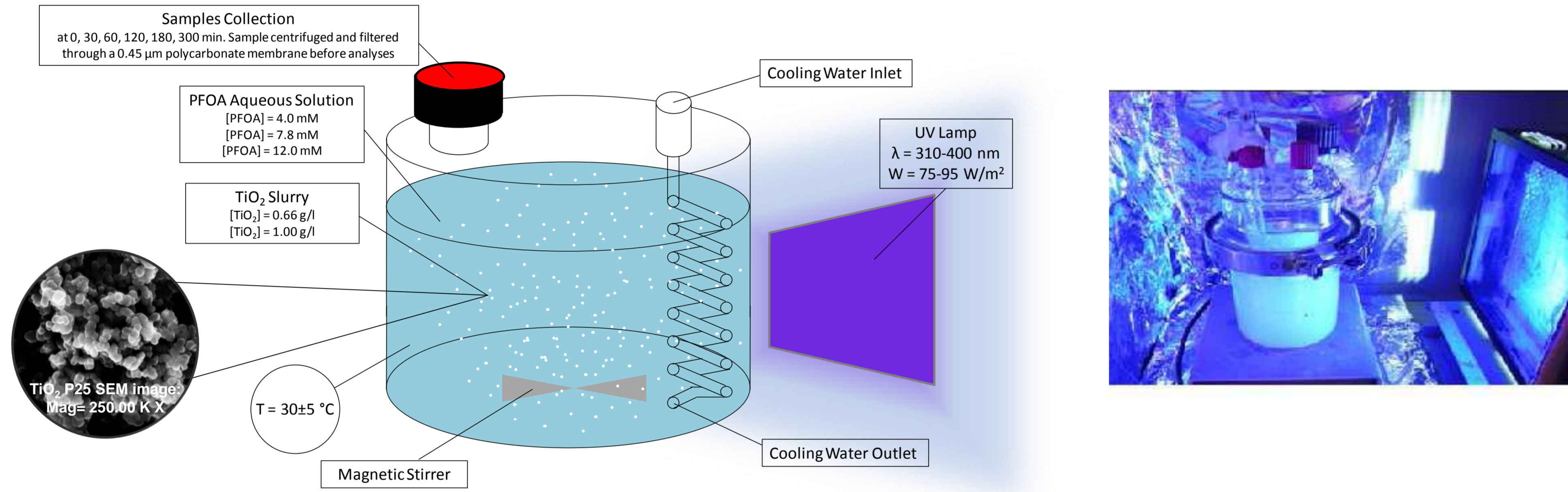
PFOA is listed as persistent organic pollutant and nowadays US-EPA (Environmental Protection Agency) and EEA (European Environment Agency) are taking action to minimize the emission of PFOA in the environment [3].



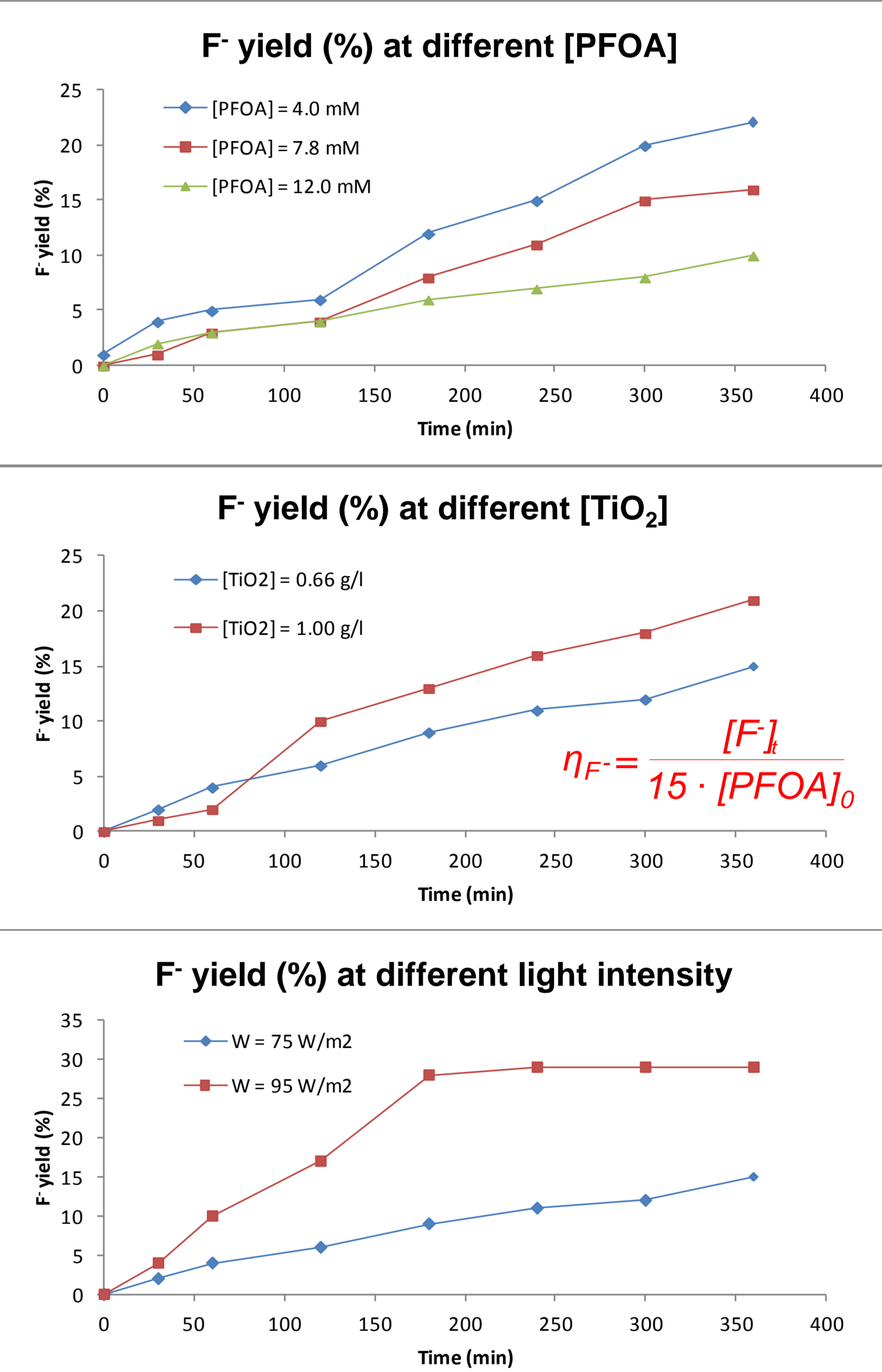
PFOA degradation through photocatalytic TiO₂



EXPERIMENTAL APPARATUS

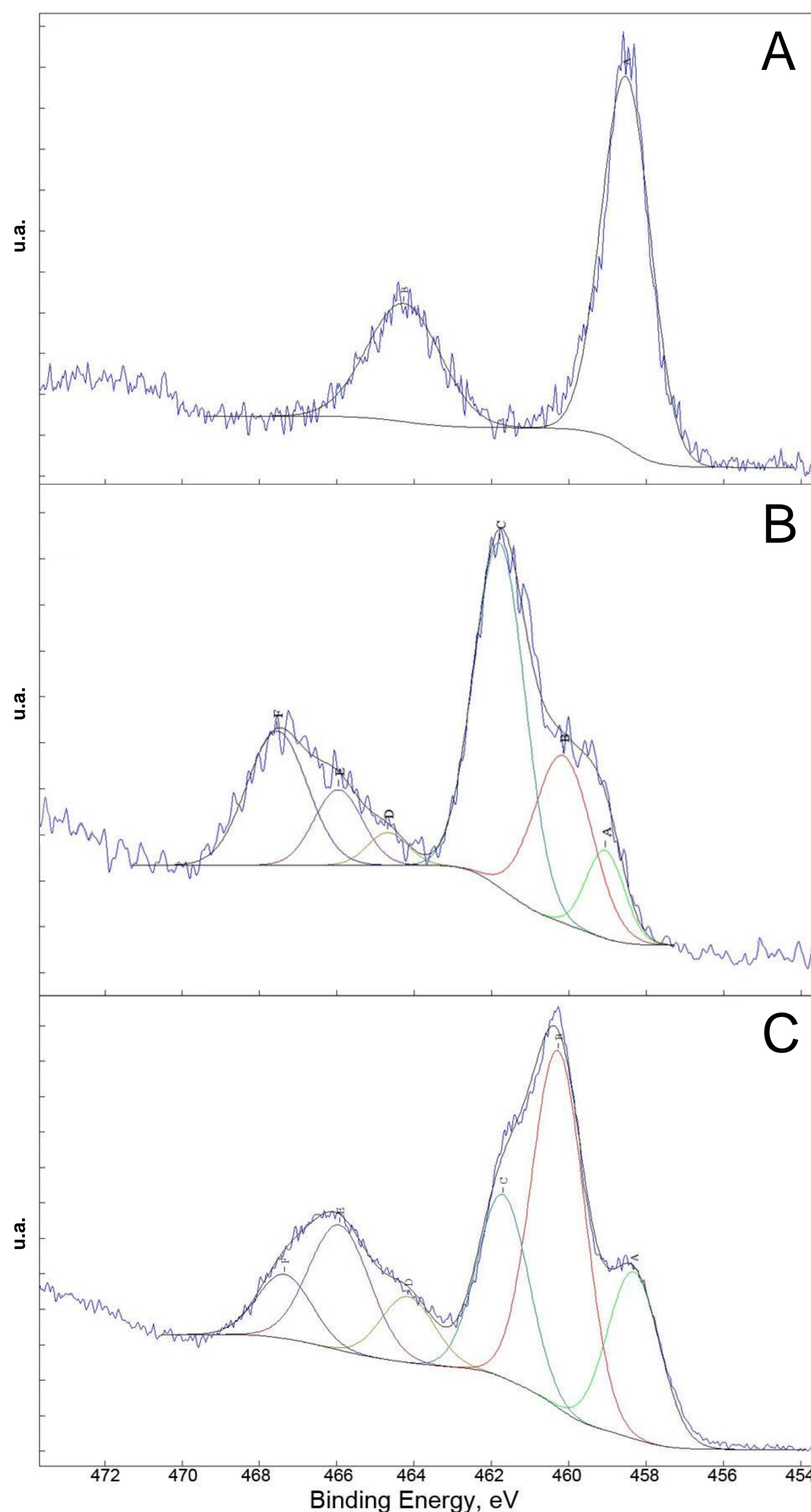


FLUORIDE IONS BALANCE



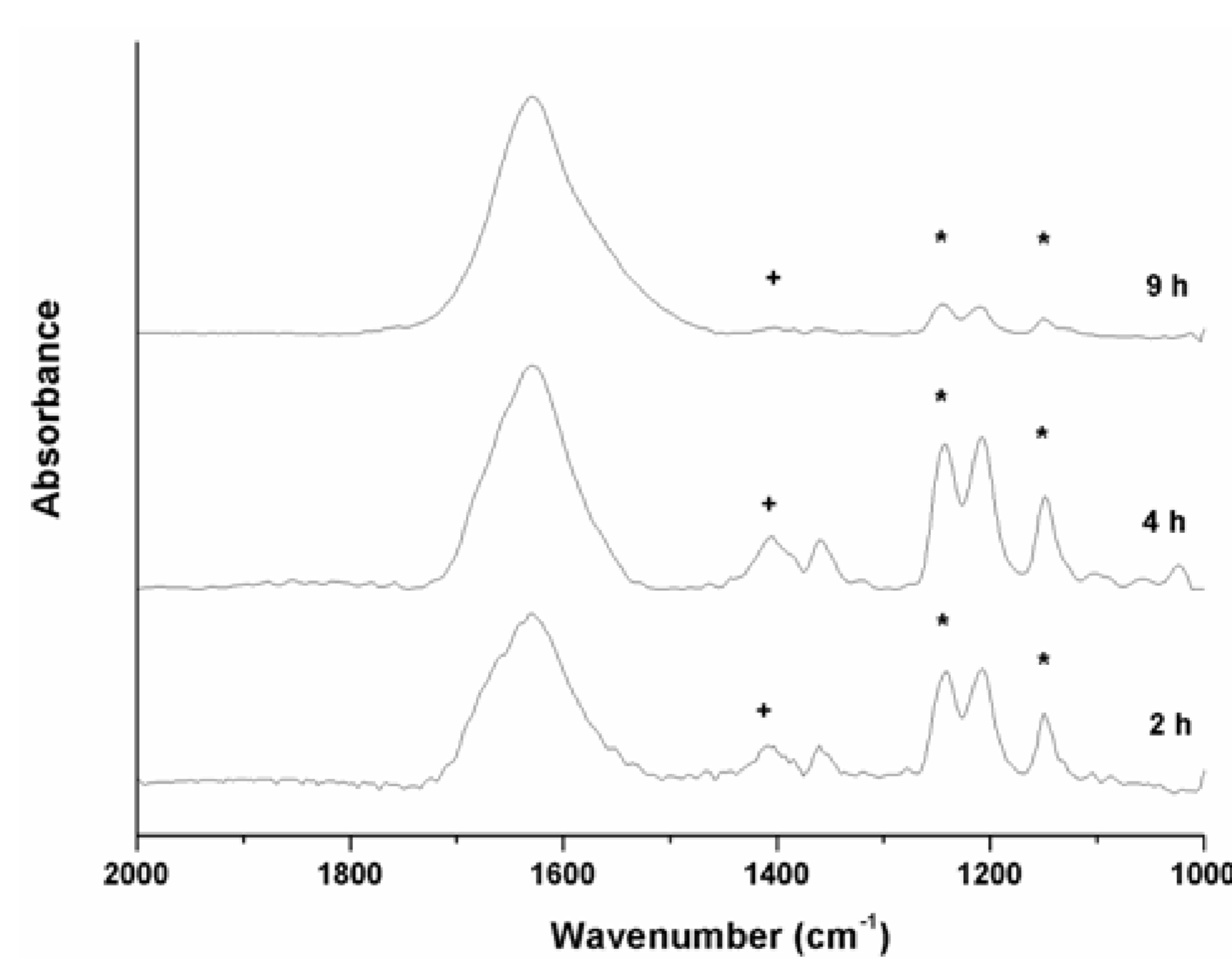
Ionic Chromatography analyses - Kinetic curves of [F⁻] growth related to PFOA degradation.

XPS ANALYSIS



Ti 2p region XPS spectra of titanium dioxide catalyst: after 4 h (A); after 9 h reaction (B); after 9 h reaction and after suspension in fluorinated solvent (C).

FT-IR ANALYSIS



FT-IR spectra of titanium dioxide catalyst at different reaction times (*) C-F stretching; (+) COO symmetric stretching.

CONCLUSIONS

- Highest PFOA degradation rates with:
 - [PFOA] < CMC (Critical Micelle Concentration)
 - [TiO₂] = 1.00 g/L
 - High radiation power, W = 95 W/m²
- Formation of highly fluorinated and hydroxylated TiO_(2-x/2-y/2)OH_yF_x species on the catalyst surface. These chemical modifications could limit the photocatalytic activity of TiO₂
- PFOA and its by-products were present on the catalyst surface in the first hours of photodegradation, while after longer reaction times the intensity of FT-IR peaks was evidently decreased.
- A plateau in F⁻ yield (%) was reached, working at the optimal degradation reaction conditions; this phenomenon could be related to the chemical modifications of the TiO₂ surface

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