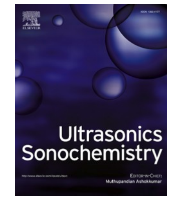
Ultrasonics Sonochemistry 71 (2021) 105388

Contents lists available at ScienceDirect

Ultrasonics Sonochemistry

journal homepage: www.elsevier.com/locate/ultson



Preface

Advanced oxidation processes (AOPs) include an ensemble of methods and technologies able to produce hydroxyl radicals ($^{\bullet}OH$) that unselectively oxidize and thus cleave organic pollutants in water or humid air. AOPs either partially cleave contaminant molecules into smaller ones or, in the best case scenario, fully oxidize them to CO_2 (CO_3^{2-} in water) and H_2O, thus attaining complete mineralization. $^{\bullet}OH$ radicals generate from either a chemical reaction or the interaction of an energy source with water (water splitting in $^{\bullet}OH$ and $^{\bullet}H$) or the species dissolved in it. The Fenton reaction series (initiated with $Fe^{2+} + H_2O_2$), ozonation reactions (initiated with $O_3 + HO^-$) belong to the first type. In the second type, photocatalysis generates $^{\bullet}OH$ radicals by the interaction of UV light with a semiconductor yielding electrons and holes (e^- and h^+), while low frequency ultrasound (US) and hydrodynamic cavitation translate into high temperatures (thousands of Kelvin) and shear rates from the collapse of the vapour cavities, generated by acoustic and hydrodynamic cavitation, respectively.

AOPs exhibit different efficiency to degrade pollutants depending on several factors, including: concentration of dissolved gases in water, pH, AOP reagents concentration, pollutant concentration, energy source intensity and density.

Energy source-based AOPs, among which US, classify as process intensification (PI) methods. To comply with PI principles, it is key to pursue the synergistic action from different processes to maximize process energy efficiency following the highest selectivity as possible to the desired products (mineralization products in this case).

US in combination with other AOPs or water treatment techniques act in fact in a synergistic way, whereby the desired response is greater than the added effect of the single processes.

We dedicate this special issue to hybrid AOPs involving US, whereby US acts in synergy with other water purification methods. These latter include photocatalysis, photoelectrocatalysis, H_2O_2, Fenton reagent, photo-Fenton, a combination of photocatalysis and H_2O_2, persulfate and peroxymonosulphate as oxidants, electrokinetic treatment to remove both organic and inorganic pollutants from soil. In this issue we also feature the simultaneous application of three methods – ultrasound, adsorption, and membrane filtration – in a hybrid process (USAMe®) as post-treatment to biological soil remediation.

In case of US combined with photocatalysis and photoelectrocatalysis, it promotes mass transfer towards the catalyst and prevents fouling by sweeping off species adsorbed on the catalyst's or electrode's surface. In combination with H_2O_2, either as a standalone reagent or a part of the Fenton reagent, US cleaves additional H_2O_2 molecules to extra $^{\bullet}OH$ radicals than the ones produced by the simple dissociation or by the simple Fenton reaction. In combination with persulfate, US generates highly oxidizing sulfate radicals ($SO_4^{\bullet}$) and, as a pre-treatment, it increases the degradation efficiency of electrokinetic treatments. In the USAMe®, US prevents the fouling of the membrane by natural organic matter, thus extending its performance and reaching nearly complete emerging pollutant degradation.

This special issue includes papers by the most eminent researchers worldwide, from 30 different institutions, working on sonochemistry and specifically sonochemistry as an AOP. We hope the readership of *Ultrasonics Sonochemistry* will appreciate this special issue's high quality content on emerging technologies based on US, which do not just contribute to the advancement of knowledge, but to achieve sustainability goals.

Prof. Daria C. Boffito is Associate Professor in Chemical Engineering at Polytechnique Montréal. She holds a Tier II Canada Research Chair in Intensified Mechano-Chemical Processes for Sustainable Biomass Conversion and she is leading the Engineering Process Intensification and Catalysis (EPIC) team. She received prestigious Canadian and international prizes, including the Emerging Leaders in Chemical Engineering (Chemical Institute of Canada, 2019), the Banting post-doctoral fellowship (2014–2016), the FRQNT PBEEE post-doctoral fellowship, the GreenTalents 2012 and the Australia Awards Endeavour Research Fellowship (2011). She is executive editor of *Ultrasonics Sonochemistry*. She works with several companies in Canada and abroad and, besides sonochemistry, her research interests include biomass conversion, photocatalysis, gas to liquids technologies, CO_2 conversion, metal extraction and synthesis of drug-delivery systems. She is also implicated in scientific communication: she authored the book" Communicate Science Papers, Presentations, and Posters Effectively" (Elsevier, 2015) and several papers on the same subject.

Prof. Claudia L. Bianchi is Full Professor of Industrial Chemistry at the Department of Chemistry at the University of Milan where she also holds the role of Coordinator and AQ referent of the Master's Degree in Industrial Chemistry. She is Head of the Departmental Analysis Laboratory that operates within the Department of Chemistry and provides chemical analysis and technical assistance services for companies, public and private research institutes. Leader of the Innovative Smart Materials for Environmental Remediation Lab (ISMER), she is life cycle analysis (LCA) expert and researcher in the field of advanced materials and sustainable catalytic and photocatalytic processes for water and air remediation. She is consultants for several Italian companies and technical expert for many Italian courts. Member of the Editorial Board of *Ultrasonics Sonochemistry*, she is also member of the Council of the European Society of Sonochemistry.

https://doi.org/10.1016/j.ultsonch.2020.105388

Available online 3 November 2020