

# The 69<sup>th</sup> Annual Meeting of the International Society of Electrochemistry

Electrochemistry from Knowledge to Innovation  
2 to 7 September 2018  
Bologna, Italy

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## Symposium 14 Electrochemical Engineering: Research towards Deployable Technology

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### Electrocatalysis

S14-001

**Estela Ruiz López** (*Chemical Engineering Department, University of Castilla-La Mancha, Ciudad Real, Spain*), Fernando Dorado Fernández, Antonio de Lucas-Consuegra

[Electrochemical promotion of Pt catalyst for hydrogen production via ethanol steam reforming](#)

### Electrochemical methods of water desalination

S14-002

**Younghyun Cho** (*Separation and Conversion Lab, Korea Institute of Energy Research, Daejeon, Korea*), Dong Kook Kim

[A Novel Three-Dimensional Desalination System Utilizing Honeycomb-Shaped Lattice Structures for Flow-Electrode Capacitive Deionization](#)

S14-003

**Pina A. Fritz** (*Food Process Engineering, Wageningen University, Wageningen, Netherlands*), Remko M. Boom, Karin Schroën

[Role of Ion Exchange Membranes in inverted Capacitive Deionization](#)

S14-004

**Lu Guo** (*Pillar of Engineering Product Development, Singapore University of Technology and Design, Singapore, Singapore*)

[Comparison of Constant Current and Constant Voltage Operation Membrane Capacitive Deionization upon Different Choices of Materials](#)

S14-005

**Pattarachai Srimuk** (*Material Science and Engineering, Saarland University, Saarbrücken, Germany*), Juhan Lee, Simon Fleischmann, Volker Presser

[Potential-dependent, switchable ion selectivity in aqueous media using titanium disulfide](#)

### Energy conversion and storage

S14-006

**Karel Bouzek** (*Department of Inorganic Technology, University of Chemistry and Technology Prague, Prague 6, Czech Republic*), Jakub Malis, Michal Cerny, Martin Paidar

[Design of Subsystem for Mobile Auxiliary Power Unit Based on PEM Fuel Cells Stack](#)

S14-007

**Jungeun Hyun** (*Energy Storage System R&D center, Korea Automotive Technology Institute, Cheonan-si, Korea*), Hyekyung Kim

[Analysis of aging effect by accelerated method](#)

S14-008

**Majid Nikfar** (*Mechanical Engineering, Isfahan University of Technology, Isfahan, Iran*), AliAkbar Alemrajabi, Dong Kook Kim, Maarten Biesheuvel

[Investigation on the Effect of Temperature of Flow-Electrode and Electrolyte on the Water Desalination Performance of FCDI](#)

S14-010

**Martin Paidar** (*Department of Inorganic Technology, University of Chemistry and Technology, Prague, Prague, Czech Republic*), Jakub Malis, Miroslav Smid, Karel Bouzek

[Influence of cell inertization and nitrogen purity on lifetime of PEM fuel cell](#)

S14-011

**Fabrizio Vicari** (*Dipartimento dell'Innovazione Industriale e Digitale (DIID), University of Palermo, Palermo, Italy*), Simona Sabatino, Adriana D'Angelo, Alessandro Galia, Onofrio Scialdone

[Study of Capacitive Electrodes for Reverse Electrodialysis Processes](#)

## Materials protection and surface modification

S14-012

**Andreas Laskos** (*CEST, Centre of Electrochemical Surface Technology, Wiener Neustadt, Austria*), Andreas Schindel, Norica Godja

[Improvement of the surface quality of additively manufactured AISi10Mg and HastelloyX parts by using chemical and electrochemical methods](#)

S14-013

**M. Emre Sener** (*Department of Chemistry, University College London, London, United Kingdom*), Daren J. Caruana

[Modulation of Copper\(I\) Oxide Reduction in Atmospheric Pressure Plasma Jet](#)

## Mathematical modelling

S14-014

**Miguel Angel Sandoval López** (*Departamento de Ingeniería Química, Universidad de Guanajuato, Guanajuato, Mexico*), Rosalba Fuentes Ramírez, José Luis Nava

[Computational Fluid Dynamic Simulations of Two-Phase Flow in a Pre-Pilot Multi-Stack Filter Press Reactor](#)

## Novel electrode materials

S14-015

**Giancarlo Banda** (*Process Engineering Post-graduation Program, Universidade Tiradentes, Aracaju, Brazil*), Géssica Santos, Laura R.A. Silva, Ronaldo Silva, Katlin Eguiluz

[Enhanced stability and electrocatalytic properties of Ti/Ru<sub>x</sub>Ir<sub>1-x</sub>O<sub>2</sub> anodes prepared by a fast CO<sub>2</sub> laser calcination](#)

S14-016

**Anna Brudzisz** (*Department of Physical Chemistry and Electrochemistry, Jagiellonian University in Krakow, Kraków, Poland*), Agnieszka Brzózka, Grzegorz Sulka

[Novel materials for electrocatalytic reduction of chloroform in water](#)

S14-017

**Mio Hayashi** (*Photocatalyst Group, Research and Development Department, Kanagawa Institute of Industrial Science and Technology, Kawasaki City, Japan*), Tsuyoshi Ochiai, Shoko Tago, Tsukaho Yahagi, Akira Fujishima

[Improvement of the Electrolysis Ozone Generation Efficiency by Platinum-modified Titanium Electrode Prepared by the Multiple Electrostrike Method](#)

S14-018

**Emília Kubináková** (*Department of Inorganic Technology, Slovak University of Technology in Bratislava, Bratislava, Slovakia*), Ján Híves, Vladimír Danielik

[Electrochemical characterization of low-temperature electrolytes for aluminium technology](#)

S14-019

**Giancosimo Sanghez de Luna** (*Dip. Chimica Industriale Toso Montanari, University of Bologna, Bologna, Italy*), Phuoc Hoang Ho, Angelo Mondello, Alice Lolli, Alessandra Petrolì, Giuseppe Fornasari, Stefania Albonetti, Patricia Benito

[3D Electrocatalysts for the Reduction of Biomass-Derived Compounds](#)

## Porous electrodes

S14-020

**Simonetta Palmas** (*Mechanical, Chemical and Material Engineering, University of Cagliari, Cagliari, Italy*), Laura Mais, Michele Mascia, Annalisa Vacca, Simona Corgiolu, Roberto Campana, Jesús Rodríguez Ruiz

[Electrochemical functionalization of porous TiO<sub>2</sub> electrodes for photocatalytic and antibacterial applications](#)

## Reactor and process design

S14-021

**Fatemeh Karimi** (*Chemical and Petrochemical Engineering, University of Calgary, Calgary, Canada*), Kunal Karan

[Gas-Phase CO<sub>2</sub> Electrolysis in Solid Polymer Electrolyte Electrochemical Cells: Some Initial Observations](#)

S14-022

**Lorenzo Pezzolato** (*DISAT - Department of Applied Science and Technology, Politecnico di Torino, Torino, Italy*), Roberto Nasi, Stefania Specchia

[Synthesis and Process Optimization of a Non-Noble Metal Catalyst for Oxygen Reduction Reaction in Alkaline Solution Based on Iron Phthalocyanine and Zeolitic Imidazolate Framework](#)

S14-023

**Kang Shi** (*Department of Chemistry, Xiamen University, Xiamen, China*), Zhen Xuan, Liang-Liang Zhang, Hui-Qing Hu, Zhong-Qun Tian, Zhao-Wu Tian

[Combination of Confined Etchant Layer Technique with Microfluidics for Large-area Nanomachining](#)

## Water treatment and environmental protection

S14-024

**Omotayo Arotiba** (*Applied Chemistry, University of Johannesburg, Johannesburg, South Africa*), Moses Peleyeju, Eseoghene Umukoro, Jonathan Babalola

[Synthesis, Characterisation and Photoelectrocatalytic Application of Titanium Sheet Supported Carbon Nanoparticle/Boron Doped BiVO<sub>4</sub>/WO<sub>3</sub> Anode for Visible-Light Degradation of Orange II Dye](#)

S14-025

**Yeray Asensio** (*Innovación y Tecnología, FCC Aqualia, Madrid, Spain*), Sara Tejedor, Patricia Fernández, Juan M. Ortiz, Víctor M. Monsalvo, Juan F. Ciriza, Juan Tolón, Frank Rogalla, Abraham Esteve, Patricia Zamora

[Combination of bio-electrochemical and electrochemical technologies as a ready-to-use solution for agrifood wastewater treatment](#)

S14-026

**Daniel J. Blackwood** (*Materials Science & Engineering, National University of Singapore, Singapore, Singapore*), Ying Wang, Samuel Lee, Kylin Liong

[A High Throughput Two Moving Belt Electrode System for Continuous Water Treatment](#)

S14-027

**María Belén Carboneras** (*Department of Chemical Engineering, University of Castilla La Mancha, Ciudad Real, Spain*), Pablo Cañizares, Manuel Andrés Rodrigo, José Villaseñor, Francisco Jesús Fernández-Morales

[Using carbon felt anodes to improve the biodegradability of soil washing effluents polluted with pesticides](#)

S14-028

**Davide Clematis** (*Department of Civil, Chemical and Environmental Engineering, University of Genoa, Genoa, Italy*), Nizar Klidi, Giacomo Cerisola, Marina Delucchi, Maria Paola Carpanese, Marco Panizza

[Solid Polymer Electrolyte: an Approach for Electrochemical Wastewater Treatment with Low Conductivity](#)

S14-029

**Nadja Maria Coelho Alves** (*Department of Chemistry, Federal University of Rio Grande do Norte, Natal, Brazil*), João Miller Melo Henrique, Chystiane do Nascimento Brito, Paola V. Guzmán, Carlos Alberto Martínez-Huitle, Elisama Vieira Santos

[Coupling of electrochemical technology powered by photovoltaic solar for the remediation of water polluted with petroleum](#)

S14-030

**Oscar Cornejo** (*Departamento de Ingeniería Geomática e Hidráulica, Universidad de Guanajuato, Guanajuato, Mexico*), Zaira Aguilar, Gilberto Carreño, José Luis Nava, Ignasi Sires

[Electrochemical Oxidation of the Azo Dye Reactive Orange 16 by Anodic Oxidation and a Fenton-like reaction](#)

S14-031

**Martín M. Dávila-Jiménez** (*Fisicoquímica, Benemérita Universidad Autónoma de Puebla, Puebla, Mexico*)

[Oxidation of Dibenzothiophene Compounds on a BDD Electrode in a Mixture of Acetonitrile-Water](#)

S14-032

**Lidia Carolina Espinoza** (*Química de los Materiales, Universidad de Santiago de Chile, Santiago, Chile*), Mateus Masteghin, Denis Martins de Godoi, Ricardo Salazar

[Nanostructured Dimensionally Stable Anodes \(DSA\) for the electro-oxidation of oxamic acid](#)

- S14-033**  
**Ana S. Fajardo** (*Centro de Ciências Exatas e da Terra, Universidade Federal do Rio Grande do Norte, Natal, Brazil*), Edilson do Vale-Júnior, Aleksandro J. dos Santos, Djalma R. da Silva, Carlos Alberto Martínez-Huitle  
[Use of electrochemical technologies for mineralization and detection of benzoquinone using Nb/BDD anodes](#)
- S14-034**  
**Juliane Forti** (*School of Sciences and Engineering, UNESP - São Paulo State University, Tupã, Brazil*), Gustavo Loretto, Renata Alves, Yasmin Tadayozzi, Eduardo Vicente, Adalgisa Andrade  
[Anodic Oxidation of Chlorophenoxy Herbicides by Oxides Electrodes](#)
- S14-035**  
**Mingming Gao** (*School of Environmental Science and Engineering, Shandong University, Jinan, China*)  
[A novel electro-Fenton-like reaction based on electrocatalytic behavior of graphite/TiO<sub>2</sub> composites towards H<sub>2</sub>O<sub>2</sub> decomposition](#)
- S14-036**  
**Sergio González-Poggini** (*Dept of Chemical Engineering, Biotechnology and Materials, Universidad de Chile, Santiago, Chile*), Melanie Colet-Lagrille  
[Design of a portable electrochemical device for water disinfection using platinum/carbon black anodes](#)
- S14-037**  
**Binbin Huang** (*Environment Science & Engineering, Hunan University, Changsha, China*), Qian Guo, Chao Lei  
[Highly effective removal of 4-chlorophenol by 3D electrode system](#)
- S14-038**  
**Yong-Gu Lee** (*Department of Water Resource, Sungkyunkwan University, Suwon, Korea*)  
[Application of sensitive electrochemical sensing system for detecting bromate in water treatment plant](#)
- S14-039**  
**Pengfei Ma** (*Dipartimento dell'Innovazione Industriale e Digitale (DIID), Università degli Studi di Palermo, Palermo, Italy*), Hongrui Ma, Simona Sabatino, Alessandro Galia, Onofrio Scialdone  
[Electrochemical Treatment of Real Wastewater with Low Conductivity](#)
- S14-040**  
**Pengfei Ma** (*School of Environment Science and Engineering, Shaanxi University of Science and Technology, Xi'an, China*), Hongrui Ma, Alessandro Galia, Simona Sabatino, Onofrio Scialdone  
[Reduction of Oxygen to H<sub>2</sub>O<sub>2</sub> at Carbon Felt Cathode in Undivided Cells – Effect of Various Operative Parameters](#)
- S14-041**  
**Carlos Alberto Martínez-Huitle** (*Institute of Chemistry, Federal University of Rio Grande do Norte, Natal, Brazil*), Soliu O. Ganiyu, Elisama Vieira dos Santos  
[Fe-rich lateritic soil catalyzed electro-Fenton degradation of food colorant Bordeaux Red \(E123\): Catalytic optimization, mineralization and reaction pathways](#)
- S14-042**  
**João Miller Melo Henrique** (*Chemical Engineering, Federal University of Rio Grande do Norte, Natal, Brazil*), Nadja Maria Coelho Alves, Eduardo Lins De Barros Neto, Carlos Alberto Martínez-Huitle, Elisama Vieira Santos  
[Electro-irradiated technologies for removing of diesel from soil-washing using solar energy](#)
- S14-043**  
**María Millán Espinar** (*Chemical Engineering Department, University of Castilla-La Mancha, Ciudad Real, Spain*), Manuel A. Rodrigo, Carme M. Fernández-Marchante, Pablo Cañizares, Justo Lobato  
[Approaching the renewable energies to electrochemical treatments of pesticides](#)
- S14-044**  
**Maria Murrieta** (*Departamento de Ingeniería Geomática e Hidráulica, Universidad de Guanajuato, Guanajuato, Mexico*), José Luis Nava  
[Degradation of the Azo Dye Acid Red 1 by electro-Fenton-like Process using hypochlorous acid and Fe<sup>2+</sup>](#)
- S14-045**  
**Slobodan Najdanovic** (*Department of Chemistry, Faculty of Sciences and Mathematics, University of Nis, Nis, Serbia*), Milica Petrovic, Milos Kostic, Miljana Radovic, Danijela Bojic, Aleksandar Bojic  
[A New Approach in Synthesis of Highly Efficient Sorbent \[Bi<sub>6</sub>O<sub>5</sub>\(OH\)<sub>3</sub>l\(NO<sub>3</sub>\)<sub>3</sub>\]<sub>2</sub>•2H<sub>2</sub>O: Electrodeposition from Ethanol Solution Followed by Thermal Treatment](#)

S14-046

**Tsuyoshi Ochiai** (*Photocatalyst Group, Research and Development Department, Kanagawa Institute of Industrial Science and Technology, Kawasaki, Japan*), Yosuke Ishikawa, Toshinari Nagura, Noritaka Kimura  
[Application of Advanced Oxidation Technologies \(AOTs\) for Bleaching of Japanese Papers \(Washi\) and Cotton Fabrics](#)

S14-047

**Alexandra Raschitor** (*Chemical Engineering Department, University of Castilla- La Mancha, Ciudad Real, Spain*), Javier Llanos, Cristina Sáez, Pablo Cañizares, Manuel A. Rodrigo  
[One-Step Concentration-Degradation Technique: Mineralization of Clopyralid from Wastewater](#)

S14-048

**Irma Robles** (*Electrochemistry, CIDETEQ, Queretaro, Mexico*), Emmanuel Becerra, Luis A. Godinez  
[Organic Matter Effect on Helminth Ova Disinfection by an Electro-Fenton Process](#)

S14-049

**Romeu C. Rocha-Filho** (*Department of Chemistry, Sao Carlos Federal University, Sao Carlos, Brazil*), Vanessa S. Antonin, José M. Aquino, Adilson J. Silva, Bianca F. Silva  
[On the Performance of Distinct Electrochemical Advanced Oxidation Processes in the Removal of Cephalexin from an Aqueous Solution](#)

S14-050

**Edgar J. Ruiz-Ruiz** (*Facultad de Ciencias Químicas, Universidad Autonoma de Nuevo Leon, Monterrey, Mexico*), Benjamín Garza-Campos, Diana Morales, Aracely Hernández-Ramírez, Jorge Guzmán-Mar, Laura Hinojosa-Reyes, Juan Manriquez  
[Air/Oxygen Diffusion Electrodes Prepared with Commercial Mesoporous Carbon and their Application in electro-Fenton Processes](#)

S14-051

**Elisama Vieira Santos** (*School of Science and Technology, avenida dos caiapos, nº 123, condominio residencial vitta I., Natal, Brazil*), Karyn Nathallye De Oliveira Silva, Samilly Cristine Alves Oliveira, Mayra Kerolly Sales Monteiro, Vítor Jorge Pais Vilar, Carlos Alberto Martínez-Huitle  
[Simple and Integrated Electrokinetic Remediation of Soil Contaminated with Lead](#)

S14-052

**Onofrio Scialdone** (*Dipartimento dell'Innovazione Industriale e Digitale (DIID), Università degli Studi di Palermo, Palermo, Italy*), Ma Peng Fei, Alessandro Galia, Simona Sabatino, Fabrizio Vicari  
[Electrochemical treatment of real wastewater with low or high conductivity](#)

S14-053

**Nena Velinov** (*Department of Chemistry, University of Nis, Nis, Serbia*), Milica Petrovic, Slobodan Najdanovic, Jelena Mitrovic, Milan Antonijevic, Aleksandar Bojic  
[Effect of Current Density on Morphology and Chemical Composition of Electrosynthesized Bi<sub>2</sub>O<sub>3</sub> Coat-based Anode and Its Use for Electrochemical Decolorization of Crystal Violet](#)

S14-054

**Anlin Xu** (*Department of Material Science and Physical Chemistry, University of Barcelona, Barcelona, Spain*), Enric Brillas, Weiqing Han, Ignasi Sires  
[Abatement of Refractory Benzothiazoles by Photoelectro-Fenton Process under Multiple Irradiation Sources \(UVA-UVC\): Kinetics and Transformation Pathways](#)

S14-055

**Zhihong Ye** (*Department of Materials Science and Physical Chemistry, University of Barcelona, Barcelona, Spain*), Enric Brillas, Pere Cabot, Francesc Centellas, Ignasi Sires  
[Degradation of Butylated Hydroxyanisole by Fe\(III\)-EDDS-Assisted Electro-Fenton Process at Neutral pH Using a Carbon-Felt Cathode](#)

S14-056

**Géssica de Oliveira Santiago Santos** (*Instituto de Tecnologia e Pesquisa, Universidade Tiradentes, Aracaju, Brazil*), Charlys Wilton dos Anjos Bezerra, Katlin Ivon Barrios Eguiluz, Giancarlo Richard Salazar-Banda  
[Preparation and characterization of RuO<sub>2</sub>-IrO<sub>2</sub>/Ti anodes by thermal decomposition method using polyvinyl polyalcohol](#)

S14-057

**Géssica de Oliveira Santiago Santos** (*Instituto de Tecnologia e Pesquisa, Universidade Tiradentes, Aracaju, Brazil*), Ronaldo Santos Silva, Katlin Ivon Barrios Eguiluz, Giancarlo Richard Salazar-Banda  
[Effect of the calcination temperature on the electrochemical properties of Ti/SnO<sub>2</sub>-Sb anodes synthesized by laser heating](#)

# Study of Capacitive Electrodes for Reverse Electrodialysis Processes

Fabrizio Vicari, Simona Sabatino, Adriana D'Angelo, Alessandro Galia, Onofrio Scialdone

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It has been calculated that the energy dissipated wherever the rivers get to the sea this corresponds to an amount of about 2 TW of power [1]. Recovering part of this energy could attenuate the dependency of our economic system from fossil fuels. The techniques conceived to exploit this *blue energy* are grouped within the family of the salinity gradient technologies, where pressure-retarded osmosis (PRO) and reverse electrodialysis (RED) are regarded as the most established technologies [2]. Nevertheless, their power is limited respectively by various factors including the kinetics of electrodes reactions. Conversely, the use of capacitive electrodes proposed by Brogioli in 2009, does not seem to be affected from these limitations, relying only on ions movement across the electrical double layer [3]. The literature highlights that RED and capacitive electrode can take advantage of their combination, implementing the Capacitive RED (CRED) [4]. In this framework, different electrochemical techniques such as cyclic voltammetry, impedance spectroscopy and chronoamperometry can be used to characterize the performance of the electrodes. These different strategies are here compared and applied to the characterization of novel, super-critical-carbon-dioxide-prepared electrodes.

## References

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2. Post JW, Veerman J, Hamelers HVM, et al (2007) Salinity-gradient power: Evaluation of pressure-retarded osmosis and reverse electrodialysis. *J Memb Sci* 288:218–230 . doi: 10.1016/j.memsci.2006.11.018
3. Brogioli D (2009) Extracting renewable energy from a salinity difference using a capacitor. *Phys Rev Lett* 103:31–34 . doi: 10.1103/PhysRevLett.103.058501
4. Vermaas DA, Saakes M, Nijmeijer K (2012) Capacitive electrodes for energy generation by reverse electrodialysis. *Procedia Eng* 44:496–497 . doi: 10.1016/j.proeng.2012.08.463