UNIVERSIDAD DE LA SERENA

LA SERENA CHILE

2nd Energy, Efficiency and Environmental Sustainability Conference 2019

16TH TO 18TH OCTOBER 2019

HOTEL CLUB LA SERENA AVENIDA DEL MAR 1000

KEYNOTE SPEAKERS

Dr. **Gianluca LI PUMA**

Loughborough University, United Kingdom.

-

Plenary conference: "Sustainable Treatment and Reuse of Agro-Industrial Wastewaters by Advanced Oxidation Processes**"**.

Dr. **Mohamad EL-ROZ**

Laboratory of Catalysis and Spectrochemistry at Caen University, France.

-

Plenary conference: "The adventure of methanol molecules on irradiated photocatalyst surface as reveals the operando FTIR spectroscopy**"**.

Dra. **María BERNECHEA**

Institute of Nanoscience of Aragon-INA, University of Zaragoza, Spain.

-

Plenary conference: "Bismuth-based colloidal nanocrystals for solution-processed solar cells**"**.

Organizing Committee

Dra. Adriana C. Mera / Universidad de La Serena

Dr. Carlos Rodríguez / Universidad de La Serena

Dr. Roberto Cabrales / Universidad de La Serena

Dr. Luis Silva / Universidad de La Serena

Dra. Sonia Montecinos / Universidad de La Serena

Dr. Francisco Gajardo / Universidad de La Serena

Dra. Shelley MacDonell / Centro de Estudios Avanzados en Zonas Áridas

Scientific Committee

Dr. Juan Carlos Durán / Universidad Nacional Autónoma de México

Dra. Monserrat Bizarro / Universidad Nacional Autónoma de México

Dr. Héctor Valdés / Universidad Católica de la Santísima Concepción

Dr. Ricardo Salazar / Universidad de Santiago de Chile

Dr. Gerardo Cabello / Universidad del BíoBío

Dr. Manuel Meléndrez / Universidad de Concepción

Dr. Danilo Carvajal / Universidad de La Serena

Dr. Nélson Moraga / Universidad de La Serena

Dra. Marcela Vázquez / Universidad Nacional de Mar del Plata

Dr. Álvaro Delgadillo / Universidad de La Serena

The event is sponsored by

Fondecyt Fondo Nacional de Desarrollo Científico y Tecnológico

PCI Programa de Cooperación Internacional

DOCTORADO EN Energía, Agua y Medio Ambiente

For more details: http://doctoradoeama.userena.cl/cees-2019/

Contact us: cees2019@userena.cl

PROGRAM AND ABSTRACT BOOK

2nd ENERGY, EFFICIENCY

AND ENVIRONMENTAL SUSTAINABILITY CONFERENCE

16-18 October 2019

Hotel Club La Serena, La Serena, Chile

Bienvenida del Vicerrector de Investigación y Postgrado de la Universidad de La Serena

La Universidad de La Serena (ULS), busca siempre cumplir con las exigencias de la sociedad y una de las demandas que más se han evidenciado en los últimos años son el problema energético y la escasez hídrica. En este contexto, las políticas institucionales en materia de investigación científica fundamental, investigación aplicada y formación de especialistas conducentes a la generación y desarrollo de energías limpias y tecnologías no contaminantes, son un eje de relevancia para la Universidad. Evidencia de aquello es la creciente productividad científica en el área y la creación de programas de Diplomados, Magister y Doctorado en temáticas de energías renovables y Sustentabilidad.

Desde un punto de vista global, el planeta está sufriendo un alza de temperatura, con consecuencias graves para los sistemas biológicos y sus equilibrios naturales. Es así como uno de los objetivos principales de la Agencia Internacional de la Energía (AIE), compuesta por 30 países, es mantener el calentamiento global por debajo de los 2 grados centígrados, siendo para ello absolutamente necesario realizar una transición a energías limpias y reducir de forma sostenible la emisión de gases con efecto invernadero. Según la AIE, el escenario de desarrollo sostenible acordado por 193 países en el año 2015, para mantener los objetivos de París, considera la necesidad de producir al menos 300 GW de nuevas capacidades de energías renovables por año hasta el 2030. Por otro lado, muchos países comienzan a acordar reducir sus emisiones a tal punto de volverlas neutras. En el caso de Chile, este año se anunció un ambicioso plan para convertir al país en carbono neutral al año 2050, proyectando para ello el cierre de todas las centrales energéticas basados a carbón y el potenciamiento de la generación de energías renovables. Ante este nuevo escenario, las nuevas tecnologías deben ser direccionadas a la consecución de los objetivos climáticos a largo plazo, siendo el desarrollo y acceso libre a la electromovilidad y la optimización de los sistemas de almacenamiento de energías obtenidas mediante fuentes renovables los desafíos que se avecinan para lograr un avance real en la transición energética y desarrollo sostenible de las naciones.

Para aportar al cambio en la matriz energética que requiere el país, necesario para enfrentar el problema que conlleva el cambio climático. En el año 2014 la ULS comenzó con un programa de investigación en la temática de energías renovables mediante un Proyecto de Mejoramiento Institucional financiado por el Ministerio de Educación, que luego dio origen a los programas de Diplomado en Eficiencia Energética y Energías Renovables No Convencionales, y Magíster en Energía y Medio Ambiente. En el año 2017, se creó el Programa de Doctorado en Energía, Agua y Medio Ambiente, y la Universidad organizó el primer congreso sobre energía, eficiencia y sustentabilidad ambiental (CEES-2017). Este segundo Congreso en Energía, Eficiencia y Sustentabilidad Ambiental 2019 es una muestra clara de la consolidación institucional que ha tenido la temática de Energía y Sustentabilidad. En ella, queda reflejado el esfuerzo de los investigadores de nuestra institución y su interés por promover la interacción con investigadores de otros centros para conversar, discutir y compartir experiencias e investigaciones que den respuestas a los desafíos que nos demanda la sociedad actual y del futuro. Este segundo congreso también favorece la formación de estudiantes nacionales e internacionales que actualmente cursan programas de Magister y Doctorado en áreas de Energía, Eficiencia y Sustentabilidad Ambiental.

Invito a los lectores a conocer las actas del congreso 2019, trabajo que sintetiza el esfuerzo de quienes realizaron tan valiosos aportes. Esperamos que el próximo año sigamos recibiendo más contribuciones y que esta iniciativa siga contribuyendo a un tema tan relevante como es la Energía, Eficiencia y Sustentabilidad Ambiental.

Cordialmente,

Eduardo Notte
Vicerrector de Investigación y Postgrado
Universidad de La Serena, Chile

Bienvenida de la Presidenta del Comité Organizador

Estimados asistentes al Segundo Congreso en Energía, Eficiencia y Sustentabilidad Ambiental (CEES 2019).

En los últimos años, la Universidad de La Serena (ULS) se ha transformado en un referente no sólo regional, sino que también nacional en las temáticas de Eficiencia Energética, Energías Renovables y Sustentabilidad Ambiental. Prueba de ello, es la adjudicación del Plan de Mejoramiento Institucional PMI 1401, en Eficiencia Energética y Sustentabilidad Ambiental, cuyo periodo de ejecución estuvo comprendido entre los años 2015-2018. Adicionalmente, el año 2018 comienza el primer año del programa de Doctorado en Energía, Agua y Medio Ambiente, y el año 2019 se suma la primera versión del Magister en Energía y Sustentabilidad Ambiental. Lo anteriormente expuesto, demuestra el firme compromiso de la institución en dichas temáticas. En este sentido, la organización del II Congreso Internacional en Energía, Eficiencia y Sustentabilidad Ambiental (II CEES 2019), consolida a la Universidad de la Serena como referente en estas temáticas, e internacionaliza su alcance con la realización de este evento internacional. Todo lo anterior, dentro de un contexto de preocupación mundial por el cambio climático, el uso eficiente de los recursos, tratamiento y reutilización de las aguas, y los diversos temas que permitan lograr un verdadero desarrollo sustentable.

El II Congreso Internacional en Energía, Eficiencia y Sustentabilidad Ambiental (II CEES-2019), tiene como finalidad promover la generación y difusión del conocimiento científico en el ámbito internacional. En su segunda versión, el congreso estará bajo la organización de La Universidad de La Serena (ULS), con apoyo de la Universidad Nacional Autónoma de México (UNAM) y la Universidad Católica de la Santísima Concepción (UCSC). A este evento, le precede el 1er CEES 2017, el Seminario Internacional en Energía, Eficiencia y Sustentabilidad (SIEES) realizado en el año 2016 y el Seminario en Energía, Eficiencia y Sustentabilidad: Economía Circular 2015.

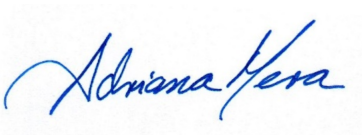
La última versión del Congreso (1er CEES 2017), permitió la participación de cerca de 120 asistentes, entre académicos e investigadores de diversas instituciones nacionales e internacionales. También se contó con la presencia de alumnos de pre y postgrado. Entre los países presentes, se destacan la participación de investigadores de Argentina, Colombia, Estados Unidos y Reino Unido. Se presentaron alrededor de 40 ponencias orales y 25 trabajos en modalidad póster.

Cabe destacar que el II CEES 2019, es posible gracias al financiamiento del proyecto de cooperación internacional (PCI) de CONICYT REDES No. 180038, el proyecto FONDECYT Regular 1170694 de la Universidad Católica de la Santísima Concepción (UCSC) y el proyecto FONDECYT iniciación 11170431 de la ULS.

Además, se cuenta con el patrocinio del Departamento de Química y de la Facultad de Ciencias de la Universidad de La Serena. Así mismo, los programas de Doctorado en Energía, Agua y Medio Ambientes y el programa de Magister en Energía y Sustentabilidad Ambiental, han puesto a disposición del comité organizador del II CEES 2019, el recurso humano necesario para la correcta ejecución del congreso. Finalmente, es mi deseo manifestar mi más profundo reconocimiento y agradecimiento a todas las instituciones nacionales e internacionales, así como a los invitados, ponentes y asistentes cuya colaboración y apoyo fue vital para la organización de este segundo CEES 2019.

En nombre del comité científico y el comité organizador esperamos que disfruten de este Congreso, teniendo la certeza que su participación en el mismo, es de trascendencia para Chile y para el mundo.

Cordialmente,



Dra. Adriana C. Mera
Académico- investigador
Instituto multidisciplinario en Ciencia y Tecnología
PMI-ULS 1401 Ineergias
Universidad de La Serena, Chile

Committees

Scientific Committee

Dr. **Juan Carlos Durán** (President)
Instituto de Ciencias Aplicadas y Tecnología
Universidad Autónoma de México, México

Dr. **Monserrat Bizarro**
Instituto de Investigaciones en Materiales
Universidad Autónoma de México, México.

Dr. **Héctor Valdéz**
Departamento de Ingeniería Industrial
Universidad Católica de la Santísima Concepción, Chile

Dr. **Ricardo Salazar**
Departamento de Química de los Materiales
Universidad de Santiago de Chile, Chile

Dr. **Gerardo Cabello**
Depto de Ciencias Básicas
Universidad del Bío-Bío, Chile.

Dr. **Manuel Meléndrez**
Departamento de Ingeniería de Materiales
Universidad de Concepción, Chile

Dr. **Danilo Carvajal**
Inst. de Investigación Multid. en Ciencia y Tecnología,
Universidad de La Serena, Benavente 980, La Serena, Chile.

Dr. **Nelson Moraga**
Departamento de Ingeniería Mecánica
Universidad de La Serena, Chile.

Marcela Vázquez
Instituto de Investigaciones en Ciencia y Tecnología de Materiales
Universidad Nacional de Mar del Plata, Argentina

Dr. **Álvaro Delgadillo**
Departamento de Química
Universidad de La Serena, Chile

Organizing Committee

Dr. **Adriana Mera** (President)
Inst. de Investigación Multid. en Ciencia y Tecnología
Universidad de La Serena, Chile.

Dr. **Carlos Rodríguez**
Inst. de Investigación Multid. en Ciencia y Tecnología
Universidad de La Serena, Chile.

Dr. **Roberto Cabrales**
Inst. de Investigación Multid. en Ciencia y Tecnología
Universidad de La Serena, Chile

Dr. **Luis Silva**
Inst. de Investigación Multid. en Ciencia y Tecnología
Universidad de La Serena, Chile.

Dr. **Sonia Montecinos**
Departamento de Física y Astronomía
Universidad de La Serena, Chile.

Dr. **Francisco Gajardo**
Departamento de Química
Universidad de La Serena, Chile

Dr. **Shelley MacDonell**
Centro de Estudios Avanzados en Zonas Áridas, Chile.

Scientific program

HORA	DIA 1 16/10/2019	
14:00	Inscripción	
	ROOM ELQUI 3	
15:00	Inauguración	
16:00	PL1	
	ROOM ELQUI 1	ROOM ELQUI 2
Chairman	Dr. Juan Durán	Dr.Héctor Valdés
17:00	SED01-A	SED01-B
17:30	SED02-A	SED02-B
18:00	SED03-A	SED03-B
18:30	Coffee	
19:30	CIERRE	

HORA	DIA 2 17/10/2019	
	ROOM ELQUI 1	ROOM ELQUI 2
Chairman	Dr. Neetu Talreja	Dr. Roberto Cabrales
09:30	SED04-A	ESS01-B
10:00	SED05-A	ESS02-B
10:30	SED06-A	ESS03-B
11:00	Coffee	
11:30	OM01-A	ESS04-B
12:00	OM02-A	ESS05-B
12:30	PL2 (ROOM ELQUI 3)	
13:30	ALMUERZO (INCLUIDO)	
	ROOM ELQUI 1	ROOM ELQUI 2
Chairman	Dr. Ricardo Salazar	Dr.Luis Silva
15:00	0M03-A	ESS06-B
15:30	OM04-A	ESS07-B
16:00	OM05-A	SEC01-B
16:30	OM06-A	SEC02-B
17:00	Coffee+Poster Session	
18:00	CIERRE	
20:30	CENA (ROOM ELQUI 3)	

HORA	DIA 3 18/10/2019	
	ROOM ELQUI 1	ROOM ELQUI 2
Chairman	Dr. Danilo Carvajal	Dr. Mohammad Ashfaq
09:15	WMU01-A	REC01-B
09:45	WMU02-A	REC02-B
10:15	Coffee	
10:45	WMU03-A	REC03-B
11:15	IT01	
11:45		IT02
12:15	PL3 (ROOM ELQUI 3)	
13:15	CLAUSURA	
13:45	Almuerzo	

TOPICS
SED: REMOVAL OF WATER AND AIR POLUTION BY SEMICONDUCTORS
REC: RENEWABLE ENERGY CONVERSION
SEC: SEMICONDUCTOR MATERIALS FOR ENERGY CONVERSION
OM: OTHER MATERIALS FOR ENERGY CONVERSION AND ENVIRONMENTAL DECONTAMINATION
ESS: ENERGY SYSTEMS AND SIMULATION
WMU: WATER MANAGEMENTS AND SUSTAINABLE WATER USAGE

Contents

Plenary Conferences

PL1: Sustainable Treatment and Reuse of Agro-Industrial Wastewaters by Advanced Oxidation Processes

Gianluca Li Puma

Environmental Nanocatalysis & Photoreaction Engineering, Department of Chemical Engineering, Loughborough University, Loughborough LE11 3TU, United Kingdom.

Presenting author's email: g.lipuma@lboro.ac.uk

Advanced Oxidation Technologies (AOTs) including, ozonation and photocatalytic oxidation are feasible and effective processes for the removal of contaminants in agro-industrial wastewaters. They also provide opportunities for water reuse and for production of renewable energy. In this study, we explore the treatment and reuse of waters from agro-industrial processes including the manufacture of cork, the production of wine, palm and olive oil, all of which are loaded with phenolic compounds, the treatment of pesticide laden wastewater and the use of glycerol waste from biodiesel production for the production of renewable hydrogen.

The integration of ozonation within the production of cork is shown through a pilot plant system, which allows almost complete water reuse [1, 2]. Ozonation and photon based-AOTs, is also shown for the treatment of winery wastewater in a pilot plant system including an evaluation of the economics of each process [3, 4, 5]. Such processes are also effective for the treatment of wastewater from the olive oil industry. The intensification of ozonation processes is shown in a novel, compact, multi-orifice oscillatory baffled column6.

Sustainable wastewater treatment can also be realized by solar photocatalysis. The effective deployment of solar photocatalytic treatment at industrial scale requires (i) the development of highly active photocatalytic materials [7] that can harvest UV and visible solar light, (ii) the development of efficient photoreactor geometries [8] and (iii) the tuning of the photoreactors to the optical properties of the photocatalyst and water matrix to be treated [9]. These aspects are discussed in this presentation through examples of treatments of real effluents from the pesticides manufacturing industry at full scale in Colombia, using a network of solar powered Compound Parabolic Collector reactors and for the treatment of urban wastewater [10].

Another important aspect is the recovery of renewable energy from the chemical species that are oxidized. The production of renewable hydrogen and/or electricity from the treatment of glycerol and urban wastewaters is demonstrated though the use of modified and novel photocatalytic materials (Ag/TiO_2 and plasmonic Ag/AgCl @ chiral TiO_2 nanofibers) and their deployment in solar powered photoreactors and photo-fuel cells [11]. These innovations open up new avenues for a sustainable approach to renewable energy production and environmental protection.

References

[1] Lan, B.Y., Nigmatullin, R., Li Puma, G., 2008, *Ozonation kinetics of cork processing water in a bubble column reactor*, Water Research, 42, pp. 2473-2482.

[2] Lan, B.Y., Nigmatullin, R., Li Puma, G., 2008, *Treatment of industrial cork processing water by ozonation and ozone based advanced oxidation processes (O3/UV and O3/H2O2) in a bubble column reactor*, Journal of Advanced Oxidation Technologies, 11(1), pp. 135-142.

[3] Lucas, M.S., Peres, J.A., Li Puma, G., 2010, *Treatment of winery wastewater by ozone-based advanced oxidation processes (O3, O3/UV and O3/UV/H2O2) in a pilot-scale bubble column reactor and process economics*, Separation and Purification Technology, 72, pp. 235-241.

[4] Lucas, M.S., Peres, J.A., Lan, B.Y., Li Puma, G., 2009, *Ozonation kinetics of winery wastewater in a pilot-scale bubble column reactor*, Water Research, 43, pp. 1523-1532.

[5] Ioannou, L.A., Li Puma, G., Fatta-Kassinos, D., 2014, *Treatment of winery wastewater by physicochemical, biological and advanced processes: A review*, Journal of Hazardous Materials,

[6] Wang, D., Li, Y., Li Puma, G., Wang, C., Wang, P., Zhang, W., Wang, Q., 2013, *Ag/AgCl @ Helical Chiral TiO_2 Nanofibers as a Visible Light Driven Plasmon Photocatalyst*, Chemical Communications, 49 (88), pp. 10367-10369

[7] Lucas, M.S., Reis, N.M., Li Puma, G., 2016, *Intesnification of ozonation processes in a novel, compact, multi-orifice oscillatory baffled column*, Chemical Engineering Journal, 296, pp. 335-339.
[8] Mueses, M.A., Machuca-Martinez, F., Li Puma, G. *Effective quantum yield and reaction rate model for evaluation of photocatalytic degradation of water contaminants in heterogeneous pilot-scale solar photoreactors*. Chemical Engineering Journal, 215-216 (2013) 937-947.
[9] Colina-Márquez, J., Machuca-Martínez, F., Li Puma, G. *Radiation absorption and optimization of solar photocatalytic reactors for environmental applications. Environmental Science and Technology*, 44 (2010) 5112-5120.
[10] Prieto-Rodriguez, L., Miralles-Cuevas, S., Oller, I., Agüera, A., Li Puma, G., Malato, S. *Treatment of emerging contaminants in wastewater treatment plants (WWTP) effluents by solar photocatalysis using low TiO2 concentrations*. Journal of Hazardous Materials, 211-212 (2012) 131-137.
[11] Wang, D., Li, Y., Li Puma, G., Wang, C., Wang, P., Zhang, W., Wang, Q., 2014, *Dye-sensitized solar cells on plasmonic Ag/AgCl @ chiral TiO2 nanofibers for treatment of urban wastewater effluents, with simultaneous production of hydrogen and electricity*, Applied Catalysis B: Environmental, in press.

Biography

Gianluca Li Puma is Professor of Chemical and Environmental Engineering at Loughborough University and leads "Environmental Nanocatalysis and Photoreaction Engineering" research in the fields of photocatalysis, environmental nanocatalysis, advanced oxidation processes, environmental applications, solar energy conversion and solar engineering. Current research is focusing on process intensification for the removal of contaminants of emerging concern and water reuse using microfluidics technology, oscillatory flow technology, photochemical, photoelectrochemical and bioelectrochemical systems. Li Puma has been Editor of "Journal of Hazardous Material" (Elsevier) and from 2019 is Editor of Applied Catalysis B: Environmental (Elsevier). He has participated as committee member or as programme chair in the organization of over 50 international conferences in catalysis, engineering and environmental science, including at ACS National Meetings and Expositions, World Congress of Chemical Engineering, SPEA, EAAOP, IWA AGRO, R&R, IAP series. Li Puma is member of the International Advisory Board of the Water Research Centres in Cyprus (NIREAS), the EPSRC Solar-Fuel Network (UK) and UK Management Committee Member of EU COST Action ES1403UK on New and Emerging Challenges and Opportunities in Wastewater Reuse (NEREUS).

PL2: Bismuth-based colloidal nanocrystals for solution-processed solar cells

Maria Bernechea[1,2,3,4]

[1]*Departamento de Ingeniería Química y Tecnologías del Medio Ambiente-Instituto de Nanociencia de Aragón, Universidad de Zaragoza, Zaragoza, España.*

[2]*Instituto de Ciencia de Materiales de Aragón-CISC, Zaragoza, España.*

[3]*Networking Biomedical Research Centre of Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), Madrid, España.*

[4]*ARAID, Zaragoza, España.*

Presenting author's email: mbernechea@unizar.es

Inorganic colloidal nanocrystals (NCs) are attractive materials for their use in solution-processed optoelectronic devices. They are generally composed of earth-abundant elements, and they can be processed from solutions, allowing an easy and cheap fabrication of devices. In the case of solar cells, they present additional attractive properties, like high absorption coefficients, tunable bandgaps, and band energy level engineering through ligand exchange.
In this field, quantum dot solar cells have already achieved efficiencies over 16.6% although employing materials composed of toxic elements (mainly Pb). In the search for new photovoltaic materials, fulfilling the desired characteristics of being environmentally friendly and low cost, we have extensively worked on bismuth-based colloidal NCs, composed of earth-abundant, non-toxic elements.
We have developed ways to modify the size and shape of the nanocrystals, and we have observed how this affects their optoelectronic properties. We have employed these NCs to fabricate solution-processed solar cells, focusing on completely non-toxic devices. Recently, we have reported a promising certified efficiency of more than 6%, employing very thin layers (35 nm) of AgBiS2 NCs. A summary of these results will be presented and future directions, such as the use of these NCs in photocatalysis, will be discussed.

Keywords: Colloidal nanocrystals, solar cells, environmentally friendly.

Biography

María Bernechea, was born in Logroño, La Rioja, Spain. She studied chemistry and obtained her PhD at Universidad de La Rioja (UR). Later, she worked at Universidad de Alcalá (UAH) and Instituto de Catálisis y Petroleoquímica (ICP-CSIC) in Madrid, and Instituto de Ciencias Fotónicas (ICFO) in Castelldefels, Barcelona. Before joining Universidad de Zaragoza as ARAID researcher in 2007 she worked as lecturer at Cardiff School of Engineering.

PL3: The adventure of methanol molecules on irradiated photocatalyst surface as reveals the operando FTIR spectroscopyy

Mohamad El-Roz

Laboratoire Catalyse et Spectrochimie-ENSICAEN, 6 Boulevard Maréchal Juin, 14050 Caen cedex, France

Tel +33 (0)231 45 28 21, Fax +33 (0)231 45 28 22

Université de Caen, CNRS www-lcs.ensicaen.fr

Presenting author's email: lcs@ensicaen.fr

Many questions remain unanswered about photocatalytic reaction mechanisms. Being able to answer some of these questions is crucial to better control the reaction. It can also extend the applications of photocatalysis to new horizons and design new materials with improved properties. The purpose of this presentation is to highlight this insight by using photocatalytic oxidation of methanol as a model reaction. Methanol is a model for many organic compounds and is a suitable molecular probe for exploring the surface properties of oxides. The photochemistry of methanol on TiO_2 has often been the model for studying the reaction mechanisms. However, the roles of excited surface species (electrons, holes and adsorbents) in the surface chemistry of TiO_2 nanoparticles are just beginning to be understood. In this talk, we show that extending the scope of FTIR operando spectroscopy, usually used in catalysis, to photocatalysis can reveal important information on the advent of methanol molecules on irradiated surface of a photocatalyst.

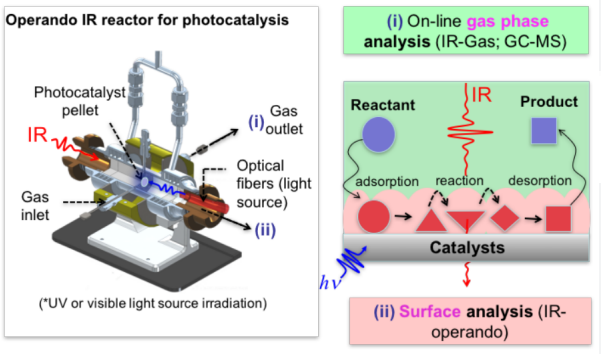


Figure 1: Left: scheme of an operando FTIR reactor developed for photocatalytic study in surface/gas phase. Right: illustration of the information collected from the different reaction steps (conversion, selectivity and involved intermediates)

Biography

Mohmad El-Roz is currently a CNRS researcher at Laboratory of Catalysis and Spectrochemistry (LCS) at Caen University in France. He obtained his MSc (2009) and PhD (2009) degrees from the University of Haute Alsace in France. He then moved to the Laboratory of Molecular and Macromolecular Photochemistry (Clermont Ferrand-France, 2009-2010) and then to LCS (2010-2013) as a postdoctor. In 2014, he was invited for 6 months at California University as junior researcher in the Joint Center of Artificial Photosynthesis at Lawrence Berkeley National Laboratory. He returned to Caen University and recruited as CNRS researcher (ring 1) in LCS. His research interest is focused on photocatalysis for environment and renewable energy. He is the author of more than 45 peer-review papers with more than a thousand of citation, 2 patents and 4 book chapters.

ESS: Energy Systems and Simulation

Oral Presentations

ESS01-B: Meteorological Assessment and Implementation of an Air-Side Free-Cooling System for Data Centers in Chile

Luis Silva[1,3], Andrés Díaz[2], Elizabeth Bermúdez[3], Diego Martínez[3], Carolina Ponce[3]

[1]*Instituto de Investigación Multidisciplinario en Ciencia y Tecnología, Universidad de La Serena, Chile.*

[2]*Escuela de Ingeniería Industrial, Universidad Diego Portales, Chile,*

[3]*Departamento de Ingeniería Mecánica, Universidad de La Serena, Chile,*

Presenting author's email: lsilva@userena.cl

Data center energy consumption in Latin America has increased considerably during the last years. According to Data Center Dynamics, energy requirements during 2016 were expected to be around 3.85 GW. In Chile, the data center industry grew 14% between 2009 and 2010, whereas energy consumption increased by 21.4% between 2012 and 2013. For this reason, many data centers in the country have started to evaluate efficient alternatives to reduce energy consumption such as the use of air containment techniques, air-side and water-side cooling systems. To date, existing free-cooling maps do not provide information about available hours during the year for implementing either air-side or water-side cooling systems in data centers in South America. This paper presents a thermodynamic analysis aimed to evaluate the potential use of air-side free-cooling systems in the Chilean data center industry. First, temperature and Relative Humidity (RH) variations, during given periods, were obtained at several different stations throughout the country. The objective was to identify regions in Chile that meet data center thermal requirements proposed by the ASHRAE. The thermodynamic model considered a white room with a thermal load of 20 kW, for which an air treatment unit was incorporated with the objective of providing cold air at 18° and 60% RH. An air treatment system was calculated at three different locations in Chile. These locations were selected since they offer high availability of fiber-optic connections (Chacalluta, Arica y Parinacota Region), a strategic position for companies (Quinta Normal, Metropolitan Region), and low temperatures through the year (Carlos Ibanez, Aysen Region). Preliminary results demonstrated that Chile is a relatively humid country. For this reason, cooling air must be dehumidified most of the time. The results also showed that even when low temperatures can be found in Carlos Ibáñez, both Chacalluta and Quinta Normal offer excellent possibilities for the data centers industry. These two last locations offer more fiber-optic connections and temperature variations that lay within the range established by the ASHRAE.

Acknowledgments

This material was partially supported by CONICYT-Chile under project FONDECYT 11160172.

ESS02-B: Wind Farm Fluid Dynamics Via Numerical Simulations and Wind Turbine Compact Modelling

Andrea Torrejón[1], Luis Silva[2], Sonia Montecinos[1]

[1]*Departamento de Física y Astronomía, Universidad de La Serena, Chile,*

[2]*Instituto de Investigación Multidisciplinario en Ciencia y Tecnología, Departamento de Ingeniería Mecánica, Universidad de La Serena, Chile.*

Presenting author's email: atorrejonf@gmail.com

The current scientific consensus indicates that the earth's climate dramatically changes, and human activities enhance this phenomenon. In particular, the immense amount of greenhouse gases released into the atmosphere since the industrial revolution caused an unprecedented rise in global temperatures. Most countries around the world agreed on reducing or downright eliminate carbon emissions in the subsequent years. Renewable energy production gained tremendous momentum in the last decade thanks to technological advancement that decreased their generation costs, which made them a viable solution when compared to traditional approaches. Wind power emerges as one of the fastest growing technologies, with an already installed capacity of 487 GW by 2016 [1], and a projection of 18% of global capacity by 2050 [2]. In this work, we modelled a small-sized wind farm using the SST k-w turbulence model, where the presence of the wind turbines is approximated via a compact model that acts as a momentum sink, representing the conversion of kinetic energy in the airflow into rotating energy at the blades. The three-dimensional unsteady simulations were carried using the software ANSYS Fluent, validated against data in the literature. We found that considering the Atmospheric Boundary Layer affects the results in non-negligible ways. We also observed an effect if the turbines are placed in a slope. In future efforts, we expect to model more complex geometries that resemble the topology of the Coquimbo region in Chile.

Acknowledgments

This article is partially funded by the Dirección de Investigación, Universidad de La Serena, Projects PR192138 and PT192139.

References

[1] Global Wind Energy Council, Global wind energy statistics. URL https://gwec.net/global-figures/wind-in-numbers/

[2] R. Kumar, K. Raahemifar, A. S. Fung, A critical review of vertical axis wind turbines for urban applications, Renewable and Sustainable Energy Reviews 89 (2018) 281–291.

ESS03-B: Data center thermal efficiency improvement by cooling flow vectoring using synthetic jets

Eduardo Sepúlveda[1], Luis Silva[2], Jean D'Alençon[1]

[1]*Department of Mechanical Engineering Departament, La Serena, Chile,*

[2]*Instituto de Investigación Multidisciplinario en Ciencia y Tecnología.*

Presenting author's email: esepulveda2@alumnosuls.cl

Electronic cooling represents a major portion of a Data Centers energy consumption, thus efficient thermal management dramatically impacts energy savings. This work proposes reducing the energy consumption associated with server air-cooling by vectoring (tilting) the main upward tile flow using adjacent synthetic jets. The particular fluid dynamics generated by synthetic jets allows controlling the angle at which the tile flow emanates, directing the cooling air toward areas with higher cooling demand. Three-dimensional simulations were performed using $k-\epsilon$ standard turbulence model with the commercial software Ansys Fluent. In order to quantify and localize the inefficien- cies of the system, we estimated the Exergy Destruction distribution in the cold aisle and servers. In previous studies, this technique proved successful in finding optimum operation conditions in Data Center cooling. As opposed to a base case without flow control, the adjacent synthetic jets directed the incoming fluid to areas with higher cooling demand, thus saving energy by avoiding over-provisioning air into servers operating under normal demand. The decrease in the overall Exergy Destruction demonstrated that vectoring improves the system's global energy efficiency.

Acknowledgments

This material is based upon work supported by CONICYT- Chile under project FONDECYT 11160172.

ESS04-B: Numerical Simulation of Passive Refrigeration System for Photovoltaic Panels by Phase Change Materials

Felipe Díaz, Nelson Moraga

Department of Mechanical Engineering, Universidad de La Serena, Chile.

Presenting author's email: fdiaz10@alumnosuls.cl

This work investigates the use of phase change materials (PCM) as a passive cooling system to increase thermal efficiency of photovoltaic panels (PV). The objective of this study is to evaluate different configurations of PV-PCM cooling systems to achieve high thermal efficiency in solar silicon cells. The development is carried out by solving the unsteady thermal energy model, that includes heat transfer by radiation, natural convection and conduction, with computational simulations by the finite volume method (MVF). A basic case of a PCM between two aluminum plates subjected to constant atmospheric conditions, emulating the conditions of a photovoltaic panel in operation, is numerically investigated first to validate the phase change model. Then, heat transfer results obtained with a second model for the PV-PCM system are validated using experimental and numerical results. Finally, the evolution of temperature in the silicon cell for different configurations of single and multiple layers of PCM in a photovoltaic panel are evaluated. The most thermal efficient configuration of the PV-PCM system is investigated under real atmospheric conditions, with the variation in time of solar radiation, wind velocity and ambient temperature, measured in a full day in a locality of the Chilean territory. It is found that the use of phase change materials as cooling system manages to decrease the temperature in the panels, avoiding losses of thermal efficiency and increasing the thermal efficiency.

Acknowledgments

The authors acknowledges the support of DIDULS, project PR183151. We thanks Solar E SpA and IM2 Solar Chile SpA for data providing.

ESS05-B: Fluid Dynamics and Heat Transfer Generated by a Pair of Adjacent Impinging Synthetic Jets

Jean D'Alençon[1], David Gallardo[1], Luis Silva-Llanca[2]

[1]*Departamento de Ingeniería Mecánica, Universidad de La Serena, Chile.*

[2]*Instituto de Investigación Multidisciplinario en Ciencia y Tecnología, Departamento de Ingeniería Mecánica, Universidad de La Serena, Chile.*

Presenting author's email: jdalencon@userena.cl

A train of counter-rotating vortex pairs can synthetize a jet-like flow, called Synthetic Jet. When a pair of adjacent synthetic jets interact, the resulting fluid dynamics vectorizes the combined flow, meaning that the flow tilts at angles that depend on the actuating conditions. In this work, we study the interactions between two adjacent synthetic jets that impinging onto a heated wall, using computational fluid dynamics. Two-dimensional simulations were performed using the SST transition turbulent model with the commercial software Ansys Fluent. The study included various operating ranges, such as: Distance to the wall (H/w), phase difference between the actuators ($\Delta\Phi$), Reynolds number (Re) and dimensionless frequency (Ω). The jet width was set as $w = 4$ mm.). The outputs of this parametric study are the average Nusselt number (Nuavg), the vectoring angle (α) and the average pumping power (Wavg). We found that when $S = w > 6$, the process of vectorization decreased, due to the poor interaction between the vortices. The pumping power was essentially independent of S/w, H/w and $\Delta\Phi$). By relating the power consumption and the heat transfer, efficient and inefficient cases were identified. Adjacent synthetic jets appear as a promising technique when the heat transfer requires flow directionality, e.g. a hot spot whose location over a heated surface varies over time

Acknowledgments

This material is based upon work supported by CONICYT Chile under project FONDECYT 11160172.

ESS06-B: Microalgae-based biorefinery: Optimization model for biofuels production

Maykol Reinoso[1], Ana Narvaez Dinamarca[2,3], Laura Azocar Ulloa[4]

[1]*Facultad de Ingeniería, Universidad Católica de la Santísima Concepción, Chile.*

[2]*Departamento de Medio Ambiente y Energía, Universidad Católica de la Santísima Concepción, Chile..*

[3]*Centro de Investigación en Biodiversidad y Ambientes Sustentables, Universidad Católica de la Santísima Concepción, Chile.*

[4]*Departamento de Química Ambiental, Universidad Católica de la Santísima Concepción, Chile.*

Presenting author's email: mreinoso@magister.ucsc.cl

Nowadays is well known that greenhouse gases and climate change are deeply affecting our environment and ecosystems. Governments are promoting policies for greener processes and industries nevertheless the progress of countries are still based on the consumption of fossil fuels. Several studies can be found for alternative fuels such as bioethanol, biodiesel and biogas; and for generation of electricity through renewable energy systems. The global bioethanol and biodiesel production reached 119 billion of gallons and 34 million of tonnes in 2016 respectively. The world biogas production was 352,780 GWh/year in 2014. Many of the feedstocks for these biofuels require a big extension of land for growing, a massive amount of water and compete with food security. Because of this drawback, new feedstocks are being studied for biofuels production, for example microalgae. The production of microalgae can be coupled with a biorefinery approach-the integrated production of bioethanol, biodiesel and biogas. From this point of view, an interesting study is to determine the optimal integrated production of biofuels which consider the fuels' sale prices, the production cost and a mix of microalgae. According to this, we have developed a linear optimization model where the variables allow the calculation of the optimal combination of diverse microalgae used for the manufacture of biofuels (bioethanol, biodiesel, biogas and amino acid concentrate), during a specific time horizon, with the aim of maximizing total revenue. Within the mathematical model, several elements are considered such as fixed and variable costs, material and energy balance, yields of individually process and microalga composition. A post-optimization and sensitivity analysis is also carried out to evaluate the effect of different variables in the system economic feasibility such as market fuels' prices, capacities of the processes and microalgae composition. The results show that the model is more sensitive to variations in prices of bioethanol and biogas than biodiesel's price.

Acknowledgments

The authors would like to gratefully acknowledge the support provided by Centro de Investigación en Biodiversidad y Ambientes Sustentables-Universidad Católica de la Santísima Concepción and CONICYT for funding the project FONDECYT Nro. 11140656.

ESS07-B: Thermal design of energy efficient passive systems for building air conditioning by phase change materials

Diego Rivera, Nelson Moraga, Dharlin Sánchez, Eduardo Miranda

Departamento de Ingeniería Mecánica, Universidad de La Serena, Chile

Presenting author's email: diego.riveraa1@userena.cl

Comfort temperature of air inside buildings, days and nights, in summer and winter months requires a high amount of energy that is based on the use of carbon, wood or hydrocarbons. These energy sources generate high levels of pollution with negative contributions to climate change. The alternative of using solar energy for air conditioning of buildings in a sustainable way by phase change materials (PCM) in passive systems is the subject of this work. Complex transport phenomena including heat radiation, turbulent mixed convective heat transfer and liquid to solid phase transformations in unsteady processes are investigated and described for energy efficient and sustainable air conditioning passive systems for buildings. Fluid mechanics and heat transfer results expressed in terms of air velocity and temperature allows the description of transport phenomena for airflows inside a solar chimney and in a room with a Trombe wall provided by PCMs. The basic knowledge required for thermal design comes from the solution of continuity, linear momentum and energy equations with the finite volume method. The evolution of solar radiation, wind velocity and ambient temperature in Vicuña, Chile, during a period of 24 hours in the coldest day of winter and in the warmer day of summer are included as boundary conditions. The first case studied provides information of the effect of thermal radiation on the turbulent natural heat convection inside a room with a phase change material. The analysis of an efficient combination of PCM, with different phase change temperatures, in the energy storage for air conditioning by solar energy is the second contribution to achieve an efficient thermal design. The third case investigates the effect of a paraffin wax as the phase change material on the unsteady heat transfer by radiation and turbulent natural convection in the variation of air temperature inside a room.

Acknowledgments

The authors acknowledge to DIDULS, Universidad de La Serena (ULS), for funds provided to project PR18351. Diego Rivera acknowledges the support received from ULS to pursue the Doctorado en Energía, Agua y medio Ambiente program.

Poster Presentations

ESSP01: $LiNO_3$ chilean as solar thermal energy storage material

Mauro Henriquez

Universidad de Antofagasta Centro de Desarrollo Energético (CDEA), Chile

Presenting author's email: mauro.henriquez@uantof.cl

The last years, Chile has been one of the most attractive solar markets due to its excellent solar conditions, in particular the Atacama Desert, which presents an annual global radiation value of 2571 kWh m-2 and an index of direct normal irradiance (DNI) of 3389 kWh m-2. This location is among the best worldwide for capturing and storing solar energy (Escobar et al. 2015) and thus Concentrated Solar Power (CSP) rises as a promising solution. These features are of major interest when considering the extensive saline deposits that are present in this region of north Chile with a great potential to be used as energy storage material (SQM 2019).One of the technological limitations in the use of solar energy is their intermittent generation during the night or cloudy days but the integration of thermal energy storage (TES) systems can help to solve this problem. The thermal storage allows a more stable generation of electrical energy and improves the variability of the solar resource to solar thermal power plants. The most common storage system is to use two tanks storing sensible heat using solar salt (60% $NaNO_3$ + 40% KNO_3) as storage media. Lithium nitrate in different proportions added to the current solar salt is one of the most promising elements to improve the properties and working ranges of the molten salts currently used in Concentrated Solar Power (CSP) (R. W. Bradshaw and Meeker 1990; Trujillo 2013; Wang, Mantha, and Reddy 2012). The use of the ternary molten salt incorporating lithium nitrate proposed in this research would reduce the lowest temperature point by almost 96°C when comparing with Solar Salt.

Acknowledgments

The authors would like to acknowledge the financial support provided by CONICYT / FONDAP 15110019 *Solar Energy Research Center* SERC-Chile. FIC-R 30413089-30488809 funded by Antofagasta Government.

OM: Other Materials for Energy Conversion and Environmental Decontamination

Oral Presentations

OM01-A: UV / H_2O_2 Process for treatment of Emerging Concern Pollutants (ECP)

Gina Hincapié-Mejía, Carlos F. Granda-Ramirez

Faculty of Architecture and Engineering, Institución Universitaria Colegio Mayor de Antioquia, Colombia

Presenting author's email: gina.hincapie@colmayor.edu.co

In the last decade, there has been a greater awareness of the called Emerging concern pollutants that, although their presence in the environment is not new, but there is concern about the possible consequences. These contaminants can be classified into five groups: personal hygiene products, pharmaceuticals, agrochemicals, industrial waste and, more recently, nanomaterials. They enter the aquatic environment through wastewater as the main source, but also from agricultural and livestock activities. Conventional wastewater treatment plants can not eliminate this type of compounds effectively; therefore, new technologies such as reverse osmosis or microfiltration have been investigated, which present a higher efficiency. However, these new processes, in addition to only transferring the pollutant from one medium to another, suppose high operation and maintenance costs, which many water service companies are not willing to pay. Given the imminent requirement for legislation on this type of pollutants, it is necessary to continue researching to obtain more efficient and accessible methods to treat water and not generate byproducts that may be more dangerous than the initial compounds. This work shows the results obtained in the application of the UV / H_2O_2 process in the elimination of Safranin T, a representative compound of industrial waste, and of Sulfacetamide and Dicloxacillin, of pharmaceutical products. A homemade reactor was used with lamps with a radiation power of 75 W (254 nm). A degradation of 64% of Safranin T was obtained with a concentration of 1 mM H_2O_2 at an exposure time of 120 minutes, as well as 78% Dicloxacillin with a concentration of 1.5 mM H_2O_2 in 60 minutes and 100% Sulfacetamide with a concentration of concentration of 0.5 mM H_2O_2 in 30 minutes.

Acknowledgments

The authors acknowledge the iucma for the financial support.

OM02-A: Biosorption with chilean brown macroalgae: experiences on copper and iron biosorption by modified dead biomass on Acid Mine Drainage (AMD).

Héctor Cid[1], Rocio Cozmar[2], Claudia Ortiz[2]

[1]*Vicerrectoria de Investigación y Posgrado, Centro de Investigaciones Costeras, Universidad de Atacama, Chile.*

[2]*Departamento de Biología, Universidad de Santiago de Chile, Chile.*

Presenting author's email: rocio.cozmar@usach.cl

Brown macroalgae biomass possess natural capacities to scavenge heavy metals, due their role on the ocean homeostasis on subtidal zones, crucial to the survival of benthonic marine species. The capacities of the brown macroalgae Macrocystis pyrifera biomass, on nom-treated biomass, and treated with nitric acid (NAc) and hydrochloric acid (HAc) were characterized, in order to stablished a step to improve the biosorption capacities on Cu and Fe ions, particularly in a complex mixture of metals and other contaminants, as is it possible to find in industrial acid mining drainage (AMD). For Cu biosorption, it was found that non-treated biomass was capable to biosorpt up to 179 mg of Cu per gram of biomass. Similarly, for Fe (II), a capacity of up to 122 mg per gram was found. For treatments over real AMD solution, obtained from real mines with a complex content of metals (Ca, Cd, Co, Cr, Cu, K, Mg, Na, Ni, Mn, Al, Fe, B, Sr, Zn, Li, Ga, Ag, Tl, Mo and V, in addition to other counterions such as carbonates and sulfate), it was found for Cu (158 mg per liter in AMD) a 13.9 % for non-treated biomass, 9.6 % for the NAc treatment, and 17,4% for HAc (representing a biosorption capacity of 6 mg per g). For Fe (200 mg per liter in AMD), natural biomass was able to biosorpt a 53.9 %, an 55.7 % NAc treated biomass and 75,3 % for NAc treated biomass (representing a biosorption capacity 20 mg per g). These results represent the first steps on biofilter developments derived of brown macroalgae biomass, in order to design derived biosorption matrices for biofilters development to treat AMD's, especially on mining countries as Chile with high environmental needs.

Acknowledgments

This work was supported by VIU-FONDEF grant VIU16P0070 : Scalable prototype of a biofilter based on Macrocystis pyrifera seaweed dead biomass for the abatement of metal contaminants on mining and industrial wastewaters

OM03-A: Functionalized mesoporous materials for metal capture.

Mauricio Gómez, Jaime Pizarro, Ximena Castillo
Departamento de Ingeniería Geográfica, Universidad de Santiago de Chile, Chile
Presenting author's email: mauricio.gomez.b@usach.cl

Water pollution by metals is a threat to the quality and availability of water. The development of highly efficient nanomaterials in metal capture will improve water reuse and contribute to the sustainable use of this resource. The objective of this study is to develop a functionalized mesoporous material for the filtration of metals in water. The precursor of the chemical structure are silica and alumina extracted from fly ash of coal combustion. Both species are obtained by an acid-base treatment and the synthesis of the mesoporous structure was carried out by a sol-gel process. The mesoporous surface was functionalized with racemic glycine (GLY), N,N-dimethylacetamide (DMAC) and carbamoyl phosphine oxide (CMPO) respectively, by grafting. All the materials were characterized by adsorption-desorption isotherms of N_2 at 77 K, X-ray fluorescence (XRF), elemental analysis (EA), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy with dispersive energy detector of X-ray (SEM-EDX), transmission electronic microscopy (TEM) and X-ray photoemission spectroscopy (XPS). The surface area obtained was 230 m^2g^{-1} and successful functionalization (to DMAC to GLY and CMPO). Mesoporous materials have capture efficiency for Fe^{3+} and La^{3+} of 70% and 95% respectively.

Keywords: *fly ash, nanomaterials, mesoporous material, N,N-dimethylacetamide, glycine.*

OM04-A: A novel Carbon-Metal-Polymeric composite for effective removal of chemical and biological contaminants.

Mohammad Ashfaq[1,2], 1,2, Carlos A. Rodríguez[1]

[1] *1Multidisciplinary Research Institute for Science and Technology, IIMCT, University of La Serena, Benavente 980, La Serena, Chile.*

[2] *School of Life Sciences, BS Abdur Rahman Crescent Institute of Science and Technology, Chennai, India.*

Presenting author's email: [A] mohdashfaqbiotech@gmail.com

The continuously increasing the existence of contaminants such as chemical and biological mainly dye, bacteria, and heavy metals ions in water bodies has increased environmental concern due to their hostile effects on living things. Therefore, it is needed to develop newer material that skirmish such environmental menace. The present works focus on the synthesis of novel polymer-metal-carbon composite for the exclusion of contaminants (both chemical and biological) from water bodies. Initially, polyurethane (PU) foam was treated with nitric acid and used as scaffold for the development of PMC. The copper nanosheet (Cu-NS) were deposited on to the functionalized PU foam to produce Cu-NS-PU material. The mechanically exfoliated graphene and mixed with chitosan to produce graphene-chitosan homogenous suspension. The produce homogenous suspension was deposited Cu- NS-PU for the development of PMC framework. The prepared PMC composite was characterized by scanning electron microscopy (SEM), Energy Dispersive X-Ray Analysis (EDX), Fourier-transform infrared spectroscopy (FT-IR), and X-rays diffraction (XRD) analysis. The prepared PMC composite was subjected to various adsorption parameter to assessed adsorption ability of the material. The prepared PMC composite was effectively used for the removal of chromium (Cr) metal ions and Congo-red (CR) dye from water system. The synthesis of PMC composite is simple, novel, cost effective, and economically viable. Therefore, prepared PMC composite has potential to be used as a filter assembly in water treatment technologies.

Acknowledgments

Authors acknowledge the financial support given by CONICYT.

Keywords: *3D-materials, polymer, metal nanosheet, contaminants, graphene*

OM05-A: Controlled pore size distribution of phenol-formaldehyde-resign based activated carbon by using metal templating approach: High performance super-capacitors.

Neetu Talreja, Adriana Mera Benavides

Multidisciplinary Research Institute in Science and Technology, GIMEGA, Universy of La Serena, Benavente 980, La Serena, Chile.

Chemistry departament, Avenida Juan Cisterna 1050, La Serena, Chile

Presenting author's email: neetutalreja99@gmail.com

Controlled pore (micro/mesopores) size distributions on carbon-based materials are highly desirable for achieving fast diffusion of electrolytes (organic and ionic) ions to enhance super-capacitance performance. However, efficient processes to control pore size, are infrequent so far. Herein advance collective metal templating and physical/chemical activation approach is developing to precisely tune porous texture (micro/mesoporous structure) on phenol formaldehyde (PF) resin based activated carbon. The combined metal templating and physical/chemical approach allow control of pore size from micro to mesoporous range. The PF resin was used as a carbon source and different metal ions (Fe+ and Zn+) used as templating agents. The micro/mesopore size can be superbly tuned from 2 to 51 nm on varying the metal ion. The carbonization and activation of metal doped PF resins gives metal based carbons micro particles (M-CMP) followed by sonication/KOH activation from M-CMP gives metal sonicated carbon micro particles (M-CMP-S) having mesopores in the range of 35-51 nm. The Fe-CMP-S and Zn-CMP-S have specific capacitances of up to 132 and 152 F/g (58 and 74 F/cm^3) at energy density of 56 and 64 Wh/Kg in ionic liquid electrolyte, respectively. The high packing density (0.5 cm^3/g), high volumetric capacitance, excellent mechanical strength, and adjustable pore size of M-CMP-S perfectly adapted for the easy diffusion of electrolyte ions, thereby high performance of super-capacitance. This work reports the newer approach that efficiently controls the pore size on carbon materials with high specific surface area, thereby effectively used in energy storage application.

OM06-A: Selective photocatalytic oxidation of 2-methoxyphenol on nanoparticles α-Fe_2O_3/TiO_2 functionalized with b-cyclodextrin.

Nicole Espinoza[1,2], Lorena Barrientos[1,2], R. Salazar[3], Caetano Flores[1]

[1] *Facultad de Química y de Farmacia, Pontificia Universidad Católica de Chile, Vicuña Mackenna 4860, Macul, Santiago, Chile.*

[2] *Núcleo milenio en Procesos Catalíticos hacia una Química Sustentable (CSC), Chile*

[3] *Facultad de Química y Biología, Universidad de Santiago de Chile, Avenida Libertador Bernardo O'Higgins 3363, Estación Central, Santiago, Chile.*

Presenting author's email: nmespinoza@uc.cl

Currently, the selection of products derived from biomass seeks to mitigate the demand for the use of petroleum products. In this sense, the use of heterogeneous photocatalysts turns out to be an attractive alternative [1]. Titanium dioxide (IV) (TiO_2) is one of the photocatalysts that stands out for its characteristics as high photocatalytic activity, chemical stability over a wide range of pH and low cost [2]. However, its main disadvantages are the low selectivity in favoring the formation of hydroxyl radicals, and the low absorption of visible radiation (5%) [3]. Consequently, modify its properties through new hybrid materials, allow to increase the selectivity and conversion. Based on the above, the anchoring of iron (III) oxide (α-Fe_2O_3) and b-cyclodextrins (b-CDs), potentially allow getting better efficiency through an increment photocatalytic response of TiO2 for the selective conversion of derivatives of the biomass.
The results of the characterization of the nanomaterial indicate that the nanoparticles have an average diameter of 10 nm for α-Fe_2O_3 and 30 nm for TiO_2. The formation of a heterogeneous union between both semiconductors was identified, due to the decrease in the energy of TiO_2 from 3.2 eV to 2.9 eV. For the selective photo-oxidation tests, it is 2-methoxyphenol as a model molecule, taking into account its partial solubility in the aqueous medium, it is that it is aware of the b-CD macromolecule to favor contact with the surface of the nanomaterial synthesized and increase the photocatalytic efficiency of the semiconductor, which is anchored to the surface of the nanomaterial. This means that the conversion rate of 2-methoxyphenol out of 77% after 90 minutes of irradiation with visible light, having a selectivity > 99% to the phenolic type derivatives, the structures dependent on the reaction conditions.

Acknowledgments

Project funded by the Research Directorate of the Office of the Vice-Chancellor for Research of the Pontifical Catholic University of Chile, through the 2018 Contest Start and "Millennium Science Initiative" of the Ministry of Economy, Development and Tourism, Chile, subsidized by the "Millennium Process Nucleus Catalytic towards a sustainable chemistry" (CSC).

References

[1] Granone LI, Sieland F, Zheng N, Dillert R, Bahnemann DW. Green Chem. 2018;20(6):1169-1192.
[2] Zhang Z, Luo Z, Yang Z, et al. RSC Adv. 2018;8(20):1219.
[3] Shakeel M, Jabeen F, Shabbir S, Asghar MS, Khan MS, Chaudhry AS. Biol Trace Elem Res. 2016;172(1):1-36.

Poster Presentations

OMP01: Surface modification by self-assembled molecules: 4-aminobenzoic acid and 4-aminothiophenol onto aluminum.

Francisca Luco-Castro[1,2], Marcos Flores[2]

[1]*Escuela de Química, FCNMM, Universidad Tecnológica Metropolitana, Santiago, Chile.*

[2]*Departamento de Física, FCFM, Universidad de Chile, Santiago, Chile.*

Presenting author's email: francisca.lucoc@utem.cl

It is possible tune the properties of thin films by change their morphology, topography or chemical composition. A route to modify the properties of metallic thin films is based on the surface functionalization by self-assembled monolayers (SAMs) of aromatic molecules. SAMs are a class of materials with potential applications in different technological fields, such as nanofabrication, chemical and biological detection. SAMs with different end group and chain length provide the opportunity to build interesting model surfaces. Recently, Ji and coworkers have published a study of a novel battery configuration based on an aluminum foil anode and a conventional cathode. The aluminum foil plays a dual role as both the active anode material and the current collector, which enhances the energy density of the packaged Lithium Ion Battery (LIB), and reduces the production cost (DOI: 10.1002/adma.201604219). But an undesirable problem appear due to the interaction of the electrolyte and the cathode, the formation of an unstable solid electrolyte interface (SEI) film and corrosion of the electrodes, resulting in deterioration of the cathodes structure. An alternative to inhibit the corrosion effect is put a SAM like a SEI in the surface of the anode. Here we present the results of a study of robust SAMs formation of 4-aminobenzoic acid (4ABA) and 4-aminothiophenol (4ATF) onto aluminum thin films. The aluminum films, of 50 nm on thickness, were evaporated by Knudsen cell onto silicon oxide substrates at room temperature. The SAMs were formed by immersion in solution at 10 mM concentrations for different time. The topography of the resulting samples were acquired by AFM, and the SAMs coverages was evidenced by angle resolved XPS (ARXPS). From these measurements, we sketched a possible configuration of SAMs on the top of the surface. The aging effect were also studied by FTIR.

Acknowledgments

This work was supported by Millenium Nucleus MultiMat and Fondecyt 1191799.

OMP02: Co-treatment and exoelectrogenic microorganisms: a strategy for remediation of old landfill leachate using Microbial Fuel Cells.

Norma Perez[1], Rodrigo Poblete[2], German Merino[1]

[1]*Departamento de Acuicultura, Universidad Católica del Norte, Chile.*

[2]*Escuela de Prevencion de Riesgos y Medio Ambiente, Universidad Católica del Norte, Chile*

Presenting author's email: norma.perez@ucn.cl

The high production of wastewater (WW) that is discharged into the sea without prior treatment represents a loss of energy and resources in a water scarcity scenario. This WW can be used for the co- treatment of more complex wastewater, such as landfill leachate (LL). Microbial fuel cells (MFC) are a sustainable alternative to degrade organic matter and recover energy from wastewater. To explore the feasibility of LL treatment, electrogenic inocula were first obtained; then, their performance in the removal of COD and ability to generate electricity from wastewater (from aquaculture and vinasse) with different proportions of pretreated LL - with UV photolysis - and without pretreatment (1%, 10% and 50%) were assessed. Seven inocula were evaluated (three wetlands sediments -TW, RW, CW-, two sewage sludge -A, B-, marine sediment -M-, and biofloc -F-). We worked with reactors (100 mL type H) with cation exchange membranes (CMI-7000S) and external resistors (250 Ω). Carbon felt (2 cm by). Carbon felt (2 cm by 2.5 cm) were used as the anode and cathode. The voltage was measured using a multimeter (ADC24). For all experiments, polarization curves were recorded. The CW and M inocula presented greater COD removal (54% and 43% respectively); therefore, they were used for the next phase. The reactors with aquaculture wastewater did not show significant changes in voltage; on the other hand, in reactors with vinasse, by increasing the proportion of pretreated LL the COD removal increased (24% with LL10%). It is proposed to increase the proportion of LL in new mixtures. These results demonstrate the initial advancements of the postdoctoral study that aims to determine the operating conditions (pretreatment of LL, mixture with WW, pH, TRH) for LL treatment using MFC.

Acknowledgments

This work was supported by FONDECYT-Postdoctoral project 3180297.

REC: Renewable Energy Conversion

Oral Presentations

REC01-B: Technology Innovation of Solar Energy: Discuss the Effect of knowledge Spillover and Collaborative Innovation.

Chun-Yao Tseng
Business Administration, Tunghai University, Taiwan
Presenting author's email: cytseng@thu.edu.tw

Owing to today's critical environmental challenges and prolonged global recession, there has been substantial investment in technology innovation of renewable energeies around the globe. Many countries generate more than 20% of their electricity with solar photovoltaics and wind. Understanding technological innovation of solar energy is very important for a firm to build competitive advantage in the world. Technology Innovation is not only inertial, but also is influenced by external might be collaborations and knowledge spillover effect, therefore connecting with other countries, different industries or inter-firms are important to enhance innovation performance. This study aims to investigate technological innovation of solar energy. Additionally, this study demonstrates which types of knowledge spillover and collaborative innovation could enhance firms' innovation performance in solar energy. This study classifies four types of knowledge spillover effect on innovation performance, including inter-national, intra-national, inter-industry and intra-industry, and types of collaborative innovation are divided into three, including inter-national co-inventors, international co-firms and intra-national co-firms. Based on patent and citation data from the US Patents and Trademark Office during 1976-2015, empirical findings are as follows. Firstly, there is a growth tendency of technological innovation in solar energy after the 2010 year, and peaking in the 2015 year. In analysis of patent count, Sunpower, Denso, Sanyo, Certain Teed and Mitsubishi are top 5 firms in the technology innovation of solar energy. On the other hand, Canon, UniRac, United Solar Systems, PowerLight and Andalay Solar are top 5 firms in analysis of citation count. Secondly, knowledge spillover from intra-industry positively and significantly increase innovation performance of solar firms, other three knowledge spillover types have no significant influence on innovation performance. Finally, collaborative innovation from international co-firms positively and significantly increase innovation performance, and there is no significant effect of collaborative innovation from international co-invectors and intra-national co-firms..

Acknowledgments

The authors would like to thank the Ministry of Sciente and Technology of Taiwan for financially supporting this study.

REC02-B: Solar absorption refrigeration: from theory to application

Danilo Carvajal

Instituto de Investigación Multidisciplinario en Ciencia y Tecnología, Universidad de La Serena, Chile

Presenting author's email: decarvajal@userena.cl

Absorption refrigeration is a promising method to utilize renewable energy for industrial applications and space cooling. Unlike the traditional vapor compression cycle, the absorption refrigeration technology can be driven directly by thermal energy (i.e. solar thermal, industrial waste heat), minimizing the use of electricity. Moreover, most of absorption cooling refrigerants are based on low global warming potential and low ozone depletion potential fluids. The aim of this work is to provide participants with a comprehensive understanding of important conceptual and empirical developments in the area of solar absorption refrigeration. Furthermore, general information about the project FIC BIP 30485945 "Solar Refrigeration for Agriculture and Aquaculture" funded by the Regional Government of Coquimbo, Chile, will be addressed. A special section will be dedicated to questions and discussion.

Acknowledgments

This project was funded by the Regional Government of Coquimbo (Chile) through grant FIC BIP 30485945 "Solar Refrigeration for Agriculture and Aquaculture"

REC03-B: Energy poverty as a barrier for transition to cleaner energy sources. The case of southern cities of Chile.

Rubén Calvo[1], Anahí Urquiza[2], Catalina Amigo[3], Marco Billi[4], Julio Labraña[5], Nicolás Álamos[6]

[1]*Departamento de Ingenieria Industrial, Universidad de Chile, Chile,*

[2]*Facultad de Ciencias Sociales, Universidad de Chile, Chile,*

[3]*Departamento de Antropología, Universidad de Chile, Chile,*

[4]*Escuela de Gobierno, Universidad Adolfo Ibáñez, Chile,*

[5]*Facultad de Educación, Universidad Diego Portales, Chile,*

[6]*Centro de Ciencia del Clima y la Resiliencia, Universidad de Chile, Chile*

Presenting author's email: rcalvo.gallardo@gmail.com

The energy transition by new materials is a central component in the political actions related to air pollution reduction. However, sociocultural variables and their possibilities to enhance or restrict this energy transition have received less attention. To face this issue, this presentation analyses the design and implementation of energy transitions policies focused on deal with high levels of air pollution, caused by the low-quality firewood use in southern cities of Chile. The policies implemented to reduce PM10 and PM2.5 concentrations do not recognize energy poverty as a barrier to socio-technical change in two senses: policies do not consider the rebound effect associated to thermal retrofit measures of dwellings or do not consider the increase of energy poverty levels due to fuel substitution - from firewood to more efficient but also expensive fuels. Emissions trajectories are described using two future scenarios: thermal retrofit and technology replacement policies. Energy poverty effects on policies efficacy are presented as an uncertainty measure that relativize their expected impacts. These results are important to understand energy poverty as an important barrier to consider the design process of policies and new technological solutions. Finally, this presentation claims that a full understanding of energy poverty should adopt a broader view and observe it as just one facet of a larger problem: territorial energy vulnerability, understood as the conditions of the territorial system and its capability to perform required energy functions, and particularly to grant households with sufficient and reliable access to energy, high quality energy services and suitable housing conditions to satisfice their energy needs. This makes it necessary to address the material and cultural dimension of energy poverty by observing the complexity of environmental, technical-infrastructural and societal conditions to drive socio-technical change.

Acknowledgments

Fondecyt nro. 11180824. Centro de Ciencia del Clima y la Resiliencia - CR2 Red de Pobreza Energética - Universidad de Chile NEST R3 - Núcleo de Estudios Sistémicos Transdisciplinarios. Riesgo, Reflexividad y Resiliencia.

Poster Presentations

RECP01: Setting module temperature of a Photovoltaic park from einvironmental parameters using Artificial Neural Networks

Sonia Montecinos[1], Andrea Torrejón[2], Carlos Rodríguez[3]

[1]*Departament of Physics and Astronomy, University of La Serena, Chile,*

[2]*Department of Mechanical Engineering, University of La Serena, Chile,*

[3]*Multidisciplinary research Institute for Sciences and technology (IIMCT), University of La Serena, Chile*

Presenting author's email: smontecinos@userena.cl

The temperature of a photovoltaic panel has a significant influence on the generation of electricity. Several authors have developed models that allow to predict the panel temperature (Tp) from air temperature (Ta) and solar radiation. Schwingshackl et al., (2013) showed that including wind speed (v) in the models improves the accuracy of Tp prediction. In this work, Artificial Neural Networks (ANN) are used to determine the dependence of Tp of an operative photovoltaic power plant (PVP) on local meteorological variables. The study is based on data registered in the Luna PVP located in the semi-arid Coquimbo Region in Chile. Luna PVP is composed of polycrystalline panels and has a nominal power of 3.46 MW. It has sensors for Tp, Ta, v, global horizontal radiation (GSR), inclined radiation (TSR) and generated energy. Two cases are analyzed, in the first one, the ANN are trained with the Tp, TSR and Ta. Secondly, wind speed is added in the training. The two cases were compared with physical models found in the literature. It is found that considering v in the prediction of Tp improves the agreement between models and observations. Finally, we found that Tp values calculated with ANN models are more accurate than those calculated with physical models: the RMSE for physical models ranged between 3.2°C and 7.2°C, the RMSE for the ANN models was lower than 2.7°C.

Acknowledgments

This article is partially financed by the Dirección de Investigación, Universidad de La Serena, Project PR192138. We thanks Solar E SpA and IM2 Solar Chile SpA for data providing.

References

[1] Schwingshackl et al., 2013. Energy Procedia 40, 77-86.

SEC: Semiconductor Materials for Energy Conversion

Oral Presentations

SEC01-B: An efficient method in the deposition of thin films of La2O3 co-doped with Er / Nd and the studies of its up-conversion properties

Gerardo Cabello[1], Claudia Caro[1], Arturo Fernandez-Perez[2], Gonzalo Buono-Core[3], Boris Chornik[4]

[1]*Departamento de Ciencias Básicas, Universidad del Bio-Bio, Chile,*

[2]*Departamento de Física, Universidad del Bio-Bio, Chile,*

[3]*Instituto de Química, P. Universidad Católica de Valparaíso, Chile,*

[4]*Departamento de Física, Universidad de Chile, Chile*

Presenting author's email: gcabello@ubiobio.cl

The term up-conversion (UC) is a type of nonlinear process in which the continuous absorption of two or more low-energy photons (near infrared radiation) leads to the emission of high energy ones (visible or ultraviolet radiation). This optical phenomenon has several applications in bio-imaging, lasers, novel display technologies and solar cells. These kinds of materials generally comprise the inorganic host, sensitizer and activators. The choice of host lattice is an important factor in obtaining efficient up- conversion processes. Among these up-conversion materials, lanthanum oxide emerge functional material due to their distinguished chemical, electrical and optical properties. Some of its optical properties include: long range of band gap 4.3-5.6 eV, long spectral range of transparency from visible to near infrared (NIR) and low phonon frequency of 400-600 cm-1. For this reason, several methods of synthesis have been used to prepare La2O3 and Er(III) doped La2O3 materials in order to study its luminescent characteristics. In this contribution a synthesis method is proposed based on the photochemical reactivity of thin films of coordination complexes as precursor materials. The first step in this process is to cast a film of an appropriate precursor complex by spin-coating. This film is exposed to UV light (λ= 254 nm), under aerated conditions resulting in the conversion of the complex precursor to the desired material as amorphous oxide films, a subsequent heat treatment is only required to obtain crystalline films. Therefore, we report the results of our study in using of La(III), Er(III) and Nd(III) β-diketonate complexes as precursors for the photochemical deposition of La2O3 thin films doped with Er and co-doped with Er/Nd and evaluate their luminescent properties as up- conversion materials. The photo-reactivity of the material precursor was monitored by Fourier transform infrared spectroscopy and UV-vis spectroscopy. The obtained samples were characterized by X-ray diffraction, X-ray photoelectron spectroscopy, energy-dispersive X-ray spectroscopy, scanning electron microscopy and UV–vis spectroscopy. The results of this characterization demonstrate the crystalline formation of La2O3:Er films and a more amorphous appearance for the of La2O3:Er/Nd films. The luminescent properties reveal that samples under 980 nm irradiation exhibit characteristic up-conversion emissions that are focused in the green region of the spectrum but that the nature of second activator (Nd) determines the degree of efficiency of these emissions.

Acknowledgments

The authors are grateful to the CONICYT-FONDEQUIP Program (No EQM-140088) for the acquisition of the Hitachi Scanning Electron Microscope (SEM). We are grateful to the Research Office at the University of Bío-Bío, project DIUBB No 181109-4/R and to CONICYT-FONDECYT Program(National Fund for Scientific and Technological Development), Chile, Grant No 1190357, for financial support.

Keywords: *Thin films, photochemical deposition, up-conversion emission, energy transfer.*

SEC02-B: Effect of sintered temperature on BiOCl film properties with potential application in DSSCs.

Luis Pizarro[1], Adriana C. Mera[2,3], C.A. Rodríguez[2,3], Juan C. Durán Álvarez[4], M. Bizarro[5]

[1] *Universidad de La Serena, Department of Mechanical Engineering, Chile.*

[2] *Universidad de La Serena, Department of Chemistry, Chile.*

[3] *Universidad de La Serena, Multidisciplinary Research Institute for Science and Technology, Chile.*

[4] *Universidad Nacional Autónoma de México, Centro de Ciencias Aplicadas y Desarrollo Tecnológico, México.*

[5] *Universidad Nacional Autónoma de México, Instituto de Investigaciones en Materiales, México.*

BiOCl semiconductor has attracted the researcher's attention due to its interesting properties as an efficient photocatalyst under UV light radiation. This material has shown its potential to compete with TiO2 as an efficient photocatalyst. The wide indirect band gap (close to 3.5 eV), low recombination rate, high electronic mobility and non-toxicity, make of BiOCl a potential candidate to be used as a semiconductor layer in Dye Sensitized Solar Cells (DSSC). In this work, BiOCl films where obtained by using the Dr. Blade method. BiOCl powder were obtained by coprecipitation method, using as precursor reagents $Bi(NO_3)_3x5H_2O$ and KCl with 10% diluted acetic acid and deionized water as solvents. From the powder obtained, a paste was elaborated adding PVP, alpha-terpineol and ethanol, which achieved the consistency similar to a toothpaste. The effect of sintered temperature (400°C, 500°C and 600°C) on the morphological, structural and optical characteristic were studied. In addition, studies were carried out on the dye absorption of the obtained films. From the scanning electron microscopy (SEM) images, it was observed homogeneous and porous films with like-flake particles. From structural characterization and through the diffraction of X rays, it was observed a phase change from the tetragonal phase for BiOCl to a monoclinic phase of Bi_2O_3 as the sintering temperature increased. From the Diffuse Reflectance Spectroscopy (DRS) measurements, it was found that all the films exhibited a band gap value close to 3 eV. Finally, the dye load in the different films is tested for different immersion times, and it was found a higher dye load for sample sintered at 400°C.

Keywords: *BiOCl, Dye Sensitized Solar Cells, semiconductors*

Poster Presentations

SECP01 Evaluation of Pt/TiO_2-Nb_2O_5 systems in the photocatalytic reforming of glycerol for the production of H_2 and CH_4

Adriana Elizabeth Lara Sandoval[1], Olga Sacco, Julie Joseane Murcia, Vincenzo Vaiano, Jose Antonio Navío, Maria del Carmen Hidalgo

[1]*Ciencias Quimicas Universidad Pedagogica y Tecnologica de Colombia, Colombia*

Presenting author's email: adrianalara_2@hotmail.com.

In the present work, the photocatalytic tests in order to evaluate the hydrogen and methane production from glycerol aqueous solution were developed by using Pt-TiO_2-Nb_2O_5 photocatalysts. firstly, individual oxides TiO_2 or Nb_2O_5 and mixed oxide were modified by Platinum. For the preparation of the mixed system, the oxides TiO2 and Nb2O5 were mixed in a defined ratio of 1:1 (Nb:Ti) in isopropanol solution as a solvent, stirring was carried out for 1 h and rotoevaporation at 82°C boiling temperature of isopropanol. For the incorporation of the metal, the photodeposition method was applied, for this hexachloroplatinic acid was used as a precursor of Pt. Isopropanol was used as a sacrificial agent (electron donor). The synthesis was carried out under a continuous flow of N2, in order to ensure a reducing atmosphere and avoid the reoxidation of the metal. The irradiation was performed by a UV lamp (365 nm). The intensity of illumination was 60 $W0m^2$. The materials were then washed, filtered and dried at 110°C for 12 h. Structural, morphological and optical properties of the photocatalysts were evaluated by different characterization techniques as N_2 physisorption, UV–Vis DRS, TEM and XPS. The photocatalytic tests were conducted in a cylindrical pyrex photoreactor. The total volume of solution was 100 mL with initial concentration glycerol equal to 5wt%. The catalyst dosage was 1.5 g/L and the irradiation was performed by four UV lamps (365 nm) was positioned around of the photoreactor in order to irradiate the volume of the solution uniformly. The irradiation time was equal to 4 hours. The analysis of the gaseous phase coming from the photoreactor was performed by using continuous analyzers (ABB Advance Optima) to measure the concentration of H2 and CH4. The best H_2 performance was obtained using Pt-TiO_2, but the Pt-TiO_2- Nb_2O_5 catalyst is even more interesting since in addition to having a good production of H_2, it also has a good production of CH_4.

Acknowledgments

Adriana E. Lara would like to thank Gobernación de Boyacá for the concession of a PhD researcher grant. This work was financed with resources from the Fondo Nacional de Financiamiento para la Ciencia, la Tecnología e Innovación (FCTel) del Sistema general de regalías (Convocatory No. 733 for the training of high level human resources of the department of Boyacá and Colciencias) and by Universidad Pedagógica y Tecnológica de Colombia.

Keywords: *glycerol, photocatalysis, hydrogen and methane.*

SECP02: Fabrication and characterization of BiOCl based dye-sensitized solar cell

Carlos Rodríguez[1], Mohammad Ashfaq[1], Adriana Mera[1], Luis Pizarro[2]

[1]*Multidisciplinary Research Institute for Science and Technology, IIMCT University of La Serena, Chile,*

[2]*Department of Mechanical Engineering University of La Serena Chile*

Presenting author's email: arodriguez@userena.cl.

The incessant increasing the demand of energy day-by-day due to increment in population, globally. Therefore, need to be develop newer material or modifying existing materials that fulfil such energy requirements. In this context, dye-sensitized solar cells (DSSCs) have potential ability to achieve the future energy requirements. A DSSC is a device composed by a photoanode which include a dye, an electrolyte and counter electrode to close de circuit. In this devices, light generates electrons in the dye and then transferred to the semiconductor material to be collected and generate electrical current. The present work focus on the fabrication of DSSCs, with special emphasis on the semiconductor material like bismuth oxychloride (BiOCl) used as photoanode. The BiOCl material was synthesized by using co-precipitation process. The BiOCl material was deposited onto the FTO-glass substrate to produce glass/FTO/BiOCl based photoanode and then immersed in dye solution (commercial aniline). The DSSCs based device was assembled with glass/FTO/BiOCl based photoanode and counter electrode to produce BiOCl material based DSSCs device. The BiOCl material was characterized by using scanning electron microscopy (SEM), and X-Ray Diffraction (XRD) analysis that confirm the homogenous film, and tetragonal phase, respectively. The diffuse reflectance spectroscopy (DRS) measurements showed that the films exhibited a band gap value ~3 eV. The conversion efficiency of BiOCl based DSSCs device was characterized by curve of current density vs voltage (J-V). The results showed that short-circuit current (Jsc), open-circuit voltage (Voc) and overall capability of the cell (FF) were measure to be 4.8×10^{-4} mAcm2, 155 mv and 35.3%, respectively. Effective conversion efficiency (η) was less than 1%. The produced BiOCl material might be excellent candidate to be used as a photoanode semiconductor, thereby BiOCl material based DSSCs device have potential ability with high conversion efficiency.

Acknowledgments

Authors acknowledge the financial support given by proyect DIDULS/ULS, through the project PR 19538513, and to the Prototype PMI-ULS 1401 project.

SECP03: Development of electrodes with semiconductor materials for fuel cells based on Plant-microorganism interaction.

Jeimy Jiseth Moscote Guerra[1], Alexandra Stoll[2], Máximo González[2]

[1] *University of La Serena. Biology department. Master in Biological Sciences mention Ecology of Arid Zones*

[2] *Center for Advanced Studies in Arid Zones - CEAZA.*

Presenting author's email: jeimy.moscote@userena.cl

The current energy demand and the depletion of fossil fuels has intensified the search for new sustainable energy sources. Among the technologies developed for this purpose, the bioelectrochemical system known as a microbial fuel cell is a prominent one, which is based on the plant-microorganism interaction. In this system, the rhizodeposits provided by the plant are transformed by the microbial community present in the soil, generating electrons that are transferred directly to an electrode. Our work sought to identify biocompatible electrodes that are more efficient at transferring electrons. For this, the following semiconductor materials were evaluated: (I) Carbon felt and powdered activated carbon, where the latter was compacted with different binding agents: (II) cyclohexane, acetone, butanone and rosin; (III) silicone and acetic acid; (IV) modified starch, clay at 80°C (V) and 350°C (VI); and concrete adhesive (VII). Once shaped, the electrodes were evaluated based on their stability and integrity under simulated field conditions (potting test), with the concrete adhesive (VII) and I) carbon felt yielding the best results. Subsequently, the selected electrodes were evaluated in the context of plant-microorganism interaction. For this, different configurations of microbial fuel cells were evaluated, considering two horizontal and vertical plane parallel arrangements, with and without lettuce plants (Lactuca Sativa); during the experiment, the electric potential was monitored by voltage generation (w / m2) using the calculation of current intensity and power density in a closed circuit with external resistance. Our results demonstrate that the use of lettuce plants in fuel cells increases electrical performance by showing values between 296.4 - 452.85mW / m2, and that the use of fuel cells configured with carbon felt electrodes and activated carbon are a promising source of non- conventional renewable energy.

Keywords: *Plant - Microbial Fuel Cells, Bioelectrodes, Carbon felt, Activated carbon, Semiconductor materials.*

SED: Removal of Water and Air Pollution by Semiconductors

Oral Presentations

SED01-A: Determination of the photocatalytic degradation mechanisms in ZnO, Bi2O3 and ZnO/Bi_2O_3 thin film heterojunctions under visible light

Alberto Bernal[1,2], Julieta Reyes[1,2], Monserrat Bizarro[1]

[1] *Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México, Circuito Exterior S/N, Ciudad Universitaria Coyoacán, CP 04510, Ciudad de México.*

[2] *Posgrado en Ciencia e Ingeniería de Materiales, Universidad Nacional Autónoma de México, CP 04510, Ciudad de México.*

Presenting author's email: albertobd0903@gmail.com

The wide interest of finding new photocatalysts that can efficiently use the solar energy as activating source has led to the development of different strategies. The most common one is the introduction of dopants into a semiconductor's matrix, in order to decrease its bandgap. However, the bandgap diminution entails also a decrease in the oxidation and reduction power of the photocatalyst, reducing its final efficiency. By contrast, the coupling of two different semiconductors seems to be a better alternative, as the best characteristics of each other can be exploited. In this work, we study the photocatalytic mechanisms that take place with two different semiconductors: ZnO and β-Bi_2O_3. The first one, a widely used photocatalyst with a bandgap of 3.2 eV, that acts through the generation of hydroxyl radicals upon UV illumination; the second, a material with a band gap of ~2.6 eV able to absorb visible radiation. Thin film coatings on glass were prepared by chemical bath using zinc acetate and bismuth acetate as precursor salts. Independent materials as well as the heterojunctions were obtained. The materials were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and UV-Vis diffuse reflectance spectroscopy. The photocatalytic activity was evaluated through the degradation of indigo carmine (IC) dye by measuring the UV-vis absorbance spectrum of IC dye as a function of reaction time under visible light irradiation. Different scavengers (such as nitrogen bubbling and ammonium oxalate) were used to identify the reactive species that lead to the degradation of IC. The results show that the heterostructures are effectively activated under visible light showing an enhanced photocatalytic response compared to the independent ZnO and Bi_2O_3 films. However, the mechanisms occurring in the heterojunctions are different from the individual semiconductors. We found that $^{\bullet}$OH radicals cannot be formed neither in visible light-illuminated ZnO nor in β-Bi_2O_3. Besides, β-Bi_2O_3 by itself produces only discoloration of IC molecule via a reductive pathway, generating the colorless Leuco-IC sub-product. In the heterojunction film we found that the main species responsible of the dye degradation are superoxide radicals and holes. The band alignment of ZnO/β-Bi_2O_3 heterojunction provides an efficient electron-hole pair generation upon visible light while preserving the oxidation potential of ZnO. This mechanism is useful for the degradation of organic pollutants in water, such as IC dye, taking advantage of the natural visible light irradiation received on Earth.

SED02-A: BiOBr and BiOI thin films for visible photocatalytic degradation of Indigo Carmine

Julio Alejandro Arana-Trenado, Monserrat Bizarro

Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México, México

Presenting author's email: alextargyn@gmail.com

Bismuth oxybromide (BiOBr) and bismuth oxyiodie (BiOI) are ternary semiconductors which have attracted attention as visible light-driven photocatalysts, as their bandgaps are around 2.7 and 2.0 eV, respectively. They show a tetragonal matlockite crystalline structure that consists of a unique layered structure and the double ionized halogen atom slabs intercalated and bounded by Van der Waals forces. This arrangement is also known as open layer and it is responsible for the inner and c–oriented electric field suspected to cause charge separation and transport improvement. BiOBr and BiOI films were obtained by ultrasonic spray pyrolysis on glass substrates at a relatively low temperature of 235°C. The films were characterized by X-ray diffraction, scanning electron microscopy, UV-vis spectroscopy and profilometry. The photocatalytic activity was tested by following the absorption spectrum of an indigo carmine (IC) dye solution with an initial concentration of 5 mg/L under low power simulated sunlight irradiation. The results show that pure BiOI and BiOBr films were obtained, no traces of precursors were observed. In both materials a layered morphology was observed by SEM. The photocatalytic response of BiOI films is achieved under acidic conditions, whereas for BiOBr films a good response is obtained at neutral pH. A detailed analysis of the absorbance spectra of IC molecule after reaction with BiOI and BiOBr films indicated that the degradation mechanisms are different. For BiOI the degradation pathway is oxidative, while for BiOBr the discoloration of IC dye is due to a reductive reaction. Differences between both mechanisms can be associated to valence band and conduction band potentials of each semiconductor and their abilities to oxidize or reduct, by direct transfer of holes or electrons to target molecule IC.

SED03-A: Building a Bi_2WO_6/Ag/AgBr composite to work as a Z-scheme for the photocatalytic degradation of antibiotics in water under visible light irradiation

Juan Carlos Durán-Álvarez, Malissa Mendez Galvan
Instituto de Ciencias Aplicadas y Tecnología, Universidad Nacional Autónoma de México, Mexico,
Presenting author's email: carlos.duran@icat.unam.mx

The continuous release of antibiotics to the environment via wastewater is becoming a priority. Since conventional depuration systems are unable to remove these substances, aquatic organisms in natural water bodies receiving effluents are facing a continuous risk of harmful effects. Advanced oxidation processes, such as heterogeneous photocatalysis have demonstrated to fully degrade antibiotics in water, thus attention is focused on developing more efficient photocatalysts. In this work, an all solid Z-scheme heterostructure was obtained to photocatalytically degrade and mineralize ciprofloxacin. Initially, Bi_2WO_6 was synthesized via the solvothermal method; then Ag^o nanoparticles were photo-deposited on its surface, followed by the precipitation of AgBr. The AgBr/Ag/Bi2WO6 heterostructure was characterized by XRD, TEM, SEM, XPS, DRS and BET. Electrochemical characterization was used to determine the potential of the valence and conduction bands of the semiconductors, as well as to elucidate the mechanisms leading to the charge carrier transference within the heterostructure. These characterizations provided the evidence to classify the synthesized heterostructure as an all solid-state Z-scheme. Photocatalytic activity tests under visible light irradiation demonstrated a clear synergistic effect of the AgBr/Ag/Bi_2WO_6 heterostructure, compared to its single components. In pure water, degradation and mineralization yields of 57% and 38% were respectively obtained upon 5 h irradiation. Then, photocatalysis was performed using tap water and initial concentration of ciprofloxacin was set at 50 μg L^{-1}. In this case, the pollutant was completely degraded and mineralized. The photocatalyst was stable upon four reaction cycles in tap water.

SED04-A: Bismuth oxyiodide (BiOI)/ synthetic zeolites composites with potential application in photocatalytic pre-treatment of wine industry wastewaters

Adriana C. Mera[5,6], Norma Sánchez[2], Francisco J Romero Salguero[3], Héctor Valdés[4], Julia Aumüller[1]

[1]*Departamento de Química, Friedrich-Alexander-University Erlangen-Nürnberg, Germany,*

[2]*Instituto de Ciencias Aplicadas y Tecnología (ICAT)Universidad Autónoma de México, Mexico*

[3]*Instituto de Quimica Fina y Nanoquimica, Universidad de Córdoba, Spain,*

[4]*Facultad de Ingeniería, Universidad Catòlica de La Santísima Concepción, Chile,*

[5]*Chemistry Departament, University of La Serena, Chile,*

[6]*Instituto de Investigación Multidisciplinario en Ciencia y Tecnología, Universidad de La Serena, Chile*

Presenting author's email: amera@userena.cl

Wine production is an important economic sector in Chile. Therefore organic matter degradation from winery wastewaters has become an important issue over the last few years. Generally, biological treatments are applied to treat winery wastewater. However, large phenolic compounds content inhibits microorganism growth on biological treatments. Therefore, a pre-treatment is required for winery wastewater to eliminate most of the phenolic compounds and to increase the effectiveness of biological cleaning. Recently, heterogeneous photo catalysis using bismuth oxyiodide (BiOI) nanoparticles provide high photocatalytic activity for phenolic compounds degradation. However, large-scale application of pure BiOI needs further attention due to problems of post-separation, recovery and reutilization of the spent photocatalyst. Thus, the key challenge is proper utilization of BiOI nano-sized semiconductor. In this context, Impregnation of BiOI onto porous support may be an alternative approach to overcome this problem. Present study describes the synthesis of pure BiOI and 10 different BiOI-synthetic zeolite composites by co-precipitation/solvothermal method. Photocatalytic efficiency of materials were determined using caffeic acid degradation at natural pH within 60 minutes under simulated solar radiation. BiOI pure, better and worst material synthesized were characterized by XRD, SEM, DRS, BET and BJH method. The results showed 79 and 83% caffeic acid degradation using pure BiOI and best composite BiOI- synthetic zeolite composite, respectively. The synthesized composite demonstrates potential applicability in photocatalytic pre-treatment of winery wastewaters under solar radiation.

Acknowledgments

The authors would like to thank the National Commission for Scientific and Technological Research (CONICYT-Chile) by FONDECYT initation 2017 Nro. 11170431 and REDES Project Nro. 180038.

SED05-A: Removal of antibiotic compounds in water using highly (001) oriented BiOI nanofilms under visible light irradiation

Juan Carlos Durán-Álvarez[1], Brenda Vargas[2], Daniel Mejía-Almaguer[1]

[1]*Instituto de Ciencias Aplicadas y Tecnología, Universidad Nacional Autónoma de México, Mexico,*

[2]*Instituto de Investigaciones en Materiales, Universidad Nacional Autónoma de México, Mexico*

Presenting author's email: carlos.duran@icat.unam.mx

Heterogeneous photocatalysis is able to completely degrade organic pollutants in water, thus this process is of interest for scientific community and organizations aimed to preserve the quality of water. The synthesis of visible-light active semiconductor thin films is one of the current priorities in order to perform sunlight-driven photocatalysis, avoiding the post-treatment step to separate the solid catalyst from the liquid phase. In this work, the Successive Ionic Layer Adsorption Reaction (SILAR) process was performed to synthesize BiOI thin films on 150×50 mm glass slides. $Bi(NO_3)_3$ and KI were used as precursors. According to XRD, the obtained nanofilms were composed by pure BiOI, highly oriented in the (001) facet. The crystallite size was 13.4 nm, while the band gap value was 2.4 eV, evidencing the capacity of the semiconductor to be photoactive under visible light irradiation. SEM and ATM displayed that the nanofilm thickness was below 500 nm along with a highly irregular topography. Photocatalytic degradation of oxytetracycline and ciprofloxacin (10 ppm) was 85% and 50%, respectively, in pure water irradiated with a 25W Xe lamp. When photocatalysis was performed in tap water, lowering the initial concentration of the organic molecules to 30 ppb, the degradation rates were maintained. Actually, the degradation of the organic molecules was the same upon four consecutive reaction cycles, demonstrating the physical and photocatalytic stability of the nanofilms. Some intermediaries of the photocatalytic process were identified by LC-MS/MS.

Acknowledgments

The authors want to acknowledge the funding given to this project by the Secretaría de Ciencia, Tecnología e Innovación de la Ciudad de México (SECITI), through the project SECITI/047/2016, as well as to the M Sc Javier Tadeo for its technical support in the elemental analysis perfomed by ICP- OES.

SED06-A: Engineering aspects of solar photo-Fenton: process simulation as scaling-up tool

Alejandro Cabrera Reina[1], Sara Miralles Cuevas[1], Lorena Cornejo Ponce[1], Sixto Malato Rodríguez[2], Isabel Oller Alberola[2]

[1]*Facultad de Ingeniería, Departamento de Ingeniería Mecánica, Universidad de Tarapacá, Chile,*

[2]*Unidad de Tratamiento Solar de Aguas, Plataforma Solar de Almería, Spain*

Presenting author's email: acabrera@limza.cl

The efficiency of solar photo-Fenton treatment is related to ambient conditions, as it depends on solar irradiance levels and operation temperature, consequently, it is highly influenced by plant location. In this context, solar photo-Fenton feasibility in three Sunbelt cities (Tabernas -Spain-, Arica -Chile- and Doha -Qatar-) for the treatment of industrial wastewater has been analysed. Process performance was simulated by means of a semi-empirical photo-Fenton model comparing the results obtained with yearly average ambient conditions and the most unfavourable monthly ambient conditions. This data was used with scaling-up purposes in order to determine the photoreactor size and reservoir tank volume needed for each case. Numerical issues were solved in MATLAB®. Finally, an economical assessment was carried out. Doha presented the lowest total costs (TC), 2.23 euros/m3, followed by Arica with 2.45 euros/m3 and Tabernas with 2.67 euros/m3 for the method based on yearly averages. For the most unfavourable ambient conditions method, the TCs were slightly higher resulting in 2.29, 2.55 and 3.11euros/m3, respectively. Cost breakdowns were analogous independently of scaling-up method and location, being amortization costs (ACs) more influenced by location than operation costs (OCs).

Acknowledgments

This work was funded by CONICYT (FONDECYT/11160680). The authors want to thank CONICYT/ FONDAP/15110019 and FONCECYT/ 11170122. Presenting author's email: acabrera@limza.cl

SED01-B: Ag NPs decorated ZnO nanostructures for the effective photocatalytic oxidation of pharmaceutical pollutants

Pugazhenthiran Nalandhiran[1], Murugesan Sepperumal[2], Suresh Santhankrishnan[3], Hector Valdés Morales[4], Mangalaraja Ramalinga Viswanathan[5]

[1]*Laboratorio de Tecnologías Limpias, Facultad de Ingeniería.*

[2]*School of Chemistry Madurai Kamaraj University, Madurai - 625 021, India.*

[3]*School of Energy, Environment and Natural Resources, Madurai Kamaraj University, Madurai - 625 021, India,*

[4]*Laboratorio de Tecnologías Limpias, Facultad de Ingeniería. Universidad Católica de la Santísima Concepción, Alonso de Ribera 2850, Concepción, Chile.*

[5]*Advanced Ceramics and Nanotechnology Laboratory, Department of Materials Engineering, Faculty of Engineering. University of Concepción, Concepción, Chile.*

Presenting author's email: npugazhmku@gmail.com

In this study, diverse zinc oxide nanostructured materials such as, ZnO nanorods (ZnO NRs), ZnO nanoflowers (ZnO NFs) and ZnO nanoparticles (ZnO NPs) decorated with silver nanoparticles were synthesized and the effect of the decoration of silver nanoparticles (Ag NPs) on structural and optical properties of zinc oxide nanostructured materials were investigated by XRD, PL and DRS techniques. HR-SEM images clearly show the existence of ZnO nanorods whose length ranges from 700 to 900 nm and diameter varies from 70 to 90 nm. The ZnO NRs have a high aspect ratio of about 10 : 1 with almost uniform size. The formed ZnO flower consists of few ZnO nanosheets that are joined to give a structure wherein the sheets look like the petals of a flower. The diameter of the flower-like structure ranged from 1 to 5 μm. Zinc oxide nanostructured materials exhibit an extended optical absorbance from UV to visible light region due to the surface plasmon resonance (SPR) feature of Ag NPs. The effect of decorated Ag NPs on the photocatalytic activity of zinc oxide nanostructured materials was investigated during the oxidation under simulated solar irradiation of ceftiofur sodium (CFS), a pharmaceutical compound normally used as an antibiotic. The CFS degradation rate over Ag-ZnO NRs is very high compared to Ag-ZnO NFs, Ag-ZnO NPs and standard TiO2 NPs (Degussa P25). Such results can be attributed to an increase on the velocity to transport photogenerated charge carriers by the one dimensional (1D) Ag-ZnO NRs. The degradation rate is much enhanced by the addition of PMS in the reaction medium and the extent of CFS mineralization is measured through TOC analyzer. All the synthesized Ag modified Zinc oxide nanostructured materials have maintained constant photocatalytic activity up to ten consecutive cycles which discloses their stability.

Acknowledgments

The author N.P. thanks to the Universidad Católica de la Santísima Concepción, Concepción, Chile for awarding Postdoctoral researcher.

SED02-B: Photocatalytic conversion of guaiacol using g-C_3N_4 catalyst

Susana Rojas de la Fuente, Nicole Espinoza Villalobos, Lorena Barrientos Poblete

Facultad de Química y Farmacia, Departamento de Química Inorgánica, Laboratorio de Nanomateriales, Pontificia Universidad Católica de Chile, Chile

Presenting author's email: sdrojas1@uc.cl

Biomass is one of the most important contaminants present in waste water from paper and agriculture industry, also it represent a versatile and renewable source for production of valuable products [1, 2], in this context, photocatalytic oxidation of biomass and its derivatives appears as a suitable method for production of more valuable materials, providing a green and straightforward route for chemical production due to the use of solar energy as source for reaction [3]. Graphitic carbon nitride (g-C_3N_4) is considered to be the most stable nanostructured carbon nitride under ambient conditions and due to its two dimensional structure and its n-type semiconductor properties with a narrow bandgap (~2.7 eV) which provides a good visible light absorption properties has been widely studied in the field of photocatalytic degradation of organic compounds [4-8] In this work, photocatalytic conversion of guaiacol (2,2-methoxyphenol) as model compound of biomass derivatives is performed using g-C_3N_4 catalyst under $\lambda \geq$320 nm light irradiation is studied. For this porpoise a xenon discharge lamp is used as UV-Vis light source, then a $CuSO_4$ (0.1 M) solution is used as light filter in order to prevent the formation of highly reactive species and avoid photolysis of guaiacol. The photocatalytic reaction was performed in aqueous solution with contaminant concentration ranging from 5-50 mg/L with dispersed catalyst in a 1 g/L proportion. Production of several phenolic compounds such as catechol (1,2- dihidroxibenceno), benzaldehyde, syringol (1,3-dimetoxi-2-hidroxibenceno) and cresol (3- methylphenol) was observed after light irradiation, the addition of bubbled oxygen during the reaction favored the production of syringol and benzaldehyde and decreased the selectivity producing other phenolic compounds.

Acknowledgments

- Nanomaterials Laboratoy. - Funding from Millennium Science Initiative of the Ministry of Economy, Development and Tourism, grant Nucleus Milenium on Catalytic Processes towards Sustainable Chemistry (CSC)

References

[1] DOI:10.1039/C7GC03522E.
[2] DOI:10.1039/C7TA03252H.
[3] DOI:10.1016/j.apcatb.2017.08.055
[4] DOI: 10.1166/jnn.2018.16037
[5] DOI:10.1016/j.apcatb.2017.01.013
[6] DOI:10.1039/C2CC35862J
[7] DOI: 10.1002/anie.201501788
[8] DOI: 10.1016/j.apcatb.2015.03.037

SED03-B: Photocatalytic system for the treatment of fecal coliform from irrigation water in the region of Coquimbo, Chile.

Álvaro Cuadra[1], María Celeste Vega Zamorano[1], Felipe Andrés Cortés[1], Adriana Consuelo Mera B[2]

[1]*Agronomy department, University of La Serena, Chile,*

[2]*Multidisciplinary Research Institute in Science and Technology, GIMEGA, University of La Serena, Chile*

Presenting author's email: celestez_07@hotmail.com

Irrigation water used for vegetable crops in the Coquimbo region contains several biological contaminants, especially fecal coliforms. Direct use of this irrigation water, decreases the production and quality of vegetable crop, in addition, presence of pathogenic microorganism creates a potential health risk to population, as these vegetables are consumed in raw state. Therefore, it is necessary to develop new treatment techniques, to reduce biological contaminants from irrigation water. Present study, focus on the photocatalytic treatment of irrigation water. Using a modified SODIS system, where titanium dioxide (TiO2) was photocatalyst and fecal coliform were used as major microbiological contaminant under UV-A radiation. Efficiency of system was evaluated using measuring the final concentration of fecal coliform. This parameter was selected as this is directly related to food safety. Commercial SODIS system utilizes of UV-C radiation which present sever health hazards, in addition, this light have a high energy consumption. In this case, modified photocatalytic system utilizes LED light as UV- A radiation, which is harmless to human health, and reduce energy consumption. Modified photocatalytic system was evaluated, by collecting sample in every 5 minutes interval for 30 minutes. Maximum removal of fecal coliforms (33.3%) was achieved after 30 min of treatment. However, ultimate goal of the study is to determine optimal time for maximum percentage removal of fecal coliform l using this system. The results obtained open up the possibility of implementing this modified photocatalytic system on several agricultural farms in the region of Coquimbo. Keywords: Vegetables, irrigation water, fecal coliforms, SODIS, efficiency, food safety, photocatalytic System.

Acknowledgments

The authors would like to the DIDULS PR17511 No. 1020102020910, prototype PMI 1401_PROT_08 and National Commission for Scientific and Technological Research (CONICYT-Chile) by: FONDECYT initation 2017 No. 11170431.

Poster Presentations

SEDP01: Photocatalytic degradation of trypan blue dye using gold-doped ZnO thin films

Alma Vázquez-Durán[1], Abraham Méndez-Albores[2], Francisco Garcia-Salinas[3], Wendy Lilian Zavala- Toledo[4]

[1]*Engineering department, National Autonomous University of Mexico-FESC, Mexico,*

[2]*Department of Engineering and Technology, National Autonomous University of Mexico-FESC, Mexico,*

[3]*Department of Materials, CINVESTAV-Querétaro, Mexico,*

[4]*Department of Materials, Universidad Tecnológica De Tecámac, Mexico*

Presenting author's email: almavazquez@comunidad.unam.mx

ZnO thin films were synthesized via sol-gel process and their surface modification was performed by gold deposition via chemical reaction in water. Thin films were characterized with scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), and UV-Vis absorption spectroscopy. UV-Vis results showed significant difference in the optical absorption between Undoped and Au-doped ZnO thin films. The photocatalytic activity was evaluated by measuring the trypan blue dye degradation in aqueous media at a concentration of 3×10^{-5}M. The results showed that the photodegradation efficiency of Au-doped ZnO thin films was slightly higher than that of Undoped ZnO. It was shown that Au-doped ZnO thin films degrade about 98

Acknowledgments

This work was supported by UNAM-DGAPA-PAPIME PE104319

SEDP02: Three dimensional BiOBr nanostructures for caffeic acid photocatalytic degradation from wastewater of wine and pisco industries

Luz Fuentes[1], Neetu Talreja[2], Adriana Mera[2]

[1]*Departamento de Química, Universidad de La Serena, Chile,*

[2]*Multidisciplinary Research Institute for Science and Technology, IIMCT, University of La Serena, Benavente 980, La Serena, Chile.*

Presenting author's email: luz.fuentes.araya@outlook.com

Present study describes the experimental and theoretical consideration of BiOBr based 3D nanosructured microsphere for the photocatalytic degradation of caffeic acid under solar simulator. BiOBr based 3D nanostructure was synthesized by solvothermal process using bismuth nitrate as precursor. Different catalytic concentration and pH condition were applied to study the effect of synthesized material on photocatalytic degradation of caffeic acid (10 ppm). In addition, a factorial design central composite (CCC) and response surface methodology was developed using MODDE 12.0.1 software, aim to evaluate the interaction between variables, and to optimize the effect of parameters over process, Maximum degradation (48.5%) was achieved within 30 min at the photocatalytic dose of 344mgL^{-1} and pH~6.7. High value of regression co-efficient (R2 0.913) confirm the applicability of model for caffeic acid degradation. The degradation follows first order kinetics with direct dependence on the solution pH as on increasing the pH, the percentage degradation increases. Furthermore, the theoretical and experimental isoelectric points (IEP) of BiOBr were found to be 2.76 which further confirm the mechanism of degradation. This study proves the applicability of 3D BiOBr microsphere towards caffeic acid photocatalytic degradation from wastewater of wine and pisco industries.

Acknowledgments

The authors would like to thank the National Commission for Scientific and Technological Research (CONICYT-Chile) by: FONDECYT initation 2017 No. 11170431 and Postdoctoral FONDECYT No. 3190515.

Keywords: *photocatalysis, caffeic acid, microspheres, solvothermal and decontamination.*

SEDP03: Bismuth oxybromide nanostructures decorated with Gold nanoparticles (BiOBr/Au) for photocatalytic degradation of phenolic compounds from wastewater

Nataly Otilia Diaz Gonzalez[1], Carolina Martínez Avelar[2], Juan C. Durán-Álvarez[2], Carlos Rodriguez[3], Adriana C. Mera B.[3]

[1]*Departamento de Minas, Universidad de La Serena, Chile,*

[2]*Departamento de micro y nanotecnología, Instituto de Ciencias Aplicadas y Tecnologia-UNAM, Mexico,*

[3]*Multidisciplinary Institute in Science and Technology, GIMEGA. Universidad de La Serena, Chile.*

Presenting author's email: nataly.odiaz@gmail.com

Protect the environment has become a priority. High levels of pollution can damage the nature and health of people. Recently, the quality of water has been of particular concern. To solve this, in recent years heterogeneous photocatalysis processes using semiconductor materials have started to be use. The most used and studied semiconductor is TiO2/P-25, however this material presents an energy gap of 3.20 [eV] and it required ultraviolet radiation (λ < 390 nm) who represents 5% of solar spectrum. This motivates searching efficient semiconductor materials under visible radiation and sunlight. Studies in recent years have shown that materials like bismuth oxybromide (BiOBr) can be used for heterogeneous photocatalysis. Improve this material could increase their photocatalytic efficiency. One innovation is decorated it with Gold nanoparticles in the surface. This works reports the preparation of bismuth oxybromide nanocomposite decorated with Gold nanoparticles (Au- BiOBr) using a facile solvothermal synthesis procedure. The synthesized nanocomposite material was characterized using: XRD, SEM/EDX, DRS, and BET surface area. The photocatalytic efficiency of the prepared Au-BiOBr nanocomposite were examined through photodegradation of caffeic acid (CA) under solar light simulator. Experimental parameters including catalyst concentration and pH were pre-confirmed with a central composed circumscribed model (CCC) and response surface methodology using MODDE 12.0.1 software. The results revealed that Au-BiOBr nanocomposite exhibits 45.0% degradation utilizing ~400 ppm of catalytic dose and pH~3.2 within 30 minutes of photocatalytic exposure. Also, a mechanism was proposed to describe the improved photocatalytic degradation of CA using Au-BiOBr where the Au plays significant role during electron transfer and in reducing the rate of electron-hole recombination. This work shows that Au-BiOBr obtained by solvothermal synthesis is a potential photocatalyst for treatment of wastewater under solar radiation.

Acknowledgments

The authors would like to thank the National Commission for Scientific and Technological Research CONICYT-Chile) by: FONDECYT initation 2017 No. 11170431 and REDES Project No. 180038 México-Chile.

SEDP04: Bismuth oxyiodide (BiOI)/Chilean natural zeolite composites for phenolic compounds degradation in wastewater

Nicole Muñoz[1], Héctor Valdés[2], Adriana C. Mera[3,4]

[1]*Department of Mining Engineering, Faculty of Engineering, University of La Serena, Chile.*

[2]*Laboratory of Clean Technologies, Faculty of Engineering, Catholic University of the Holy Conception, Chile.*

[3]*Institute of Multidisciplinary Research in Science and Technology, University of La Serena, Chile.*

[4]*Central Laboratory of Chemical Analysis, Department of Chemistry, University of La Serena, Chile*

Presenting author's email: nmunoz6@alumnosuls.cl

Recently, bismuth oxyiodide (BiOI) semiconductor has received much attention because this material shows a high laboratory scale photocatalytic efficiency in the degradation and mineralization of various contaminants. In addition, the photocatalytic activity of the BiOI is higher than that presented by the commercial reference TiO2 *Evonik* P-25 under visible light or simulated solar radiation. However, pure BiOI presents similar problems to TiO2/P-25 for possible large-scale application. Therefore, the key challenge for a possible use of BiOI in industrial scale wastewater treatment lies in immobilization of this nanometer-sized semiconductor on a larger support, thus facilitating a process of post-separation, recovery and efficient reuse of this material. In this context, immobilization of pure BiOI onto porous support may be an alternative approach to overcome this problem. Natural zeolites are used as support for semiconductors. These materials are attractive candidates due to their unique properties, especially because they exhibit high thermal stability. In addition, these materials are readily available and inexpensive in Chile. In this study, BiOI- Chilean natural zeolite composites were obtained using the solvothermal method and microwave-assisted solvothermal synthesis, using ethylene glycol as the solvent.The materials obtained were characterized using different techniques: X-ray diffraction (XRD), scanning electron microscopy (SEM), N2 adsorption-desorption isotherms (BET) and diffuse reflectance UV-visible spectroscopy (DRS). Photocatalytic efficiency of the obtained materials was calculated using phenolic compounds (caffeic acid and gallic acid) degradation percentages under simulated solar radiation by 120 minutes, phenolic compounds degradation was evaluated using the techniques: high efficiency liquid chromatography (HPLC) and UV-visible spectroscopy. Results show that the composite obtained using microwave-assisted solvothermal synthesis provides best phenolic compounds percentage degradation. Then, this composite have a potential large-scale application for heterogeneous photocatalytic pre-treatment of wastewater with phenolic pollutants.

Acknowledgments

The authors would like to thank the National Commission for Scientific and Technological Research (CONICYT-Chile) by FONDECYT initation 2017 No. 11170431.

69

WMU: Water management and Sustainable Water Usage

Oral Presentations

WMU01-A: Electrochemical Raceway Pond Reactor: Degradation of Organic Pollutants by Solar photoelectro-Fenton

Ricardo Salazar

Department of Chemistry of Materials, University of Santiago of Chile, Chile

Presenting author's email: ricardo.salazar@usach.cl

Raceway pond reactors (RPR) are common low-cost reactors which can treat large volumes of water consists of open channels through which the water is moved by a paddle wheel. A raceway pond reactor collect light less efficiently but are cheaper than tubular reactors with compound parabolic collectors (CPCs), commonly used for solar applications. RPRs are a good option for treating wastewater, as open photoreactors could be used for wastewater containing low concentrations of contaminants which are not very toxic and require treatment time of only a few minutes. Our proposal was to include an electrochemical filter press cell to generate hydrogen peroxide and make the water flow in the RPR by a pump, without the use of the paddle wheel commonly used in this type of reactor. In the presence of Fe^{2+}, the hydrogen peroxide generated, produces hydroxyl radicals, through the Fenton reaction (electro-Fenton process, EF), that react with the organic contaminants until their complete mineralization to carbon dioxide. EF process is improved by irradiating the treated solution with UVA lamp or direct sun light, which photoreduced $Fe(OH)^{2+}$, regenerating more Fe^{2+} ion and producing more $^{\bullet}OH$, and photodegraded Fe(III) complexes with produces carboxylic acids formed during the degradation of pollutants. The treatment of 20 L of wastewater containing 0.050 M Na_2SO_4 has been investigated by EF and solar photoelectro-Fenton (SPEF) processes in an RPR coupled to filter press electrochemical cell equipped with a DSA-type anode and an air-diffusion electrode (ADE) as cathode. The performance of each treatment was assessed by UV-Vis spectrophotometry, TOC, HPLC and GC-MS analyses. The effect of some relevant operation parameters such as the applied current, the concentration of electro-generate peroxide on the PEF process efficiency and the formation of intermediates was thoroughly evaluated. A homogeneous distribution of the electro-generated H2O2 is obtained. Complete mineralization of organic pollutants is achieved using SPEF.

Acknowledgments

The author thank CONICYT (Chile) for financial support under FONDECYT project No. 1170352 and FONDAP CONICYT SERC Chile 15110019.

WMU02-A: Fog water as a new source of water for sustainable irrigation of olive trees orchard in the Atacama Desert

Francisco Tapia[1], Pedro Hernández

[1]*Horticulture research program, Instituto de Investigaciones Agropecuarias, Chile*

Presenting author's email: fatapiac@inia.cl

The Atacama Desert - considered the most arid in the world - it presents favorable climatic and soil conditions for the production of olive oil with high functional quality, however, the limitation for its development is the availability of irrigation water. The coastal of the Atacama Desert (25◦26'00"S and 70◦27'08"W), presents abundant fog, which usually comes from the ocean towards the continent impacting coastal mountains. To give productive use to this new water source, between 2017 and 2018, a project was carried out to use fog water as a new source to meet the needs of olive irrigation, installing fog collectors at different heights in the mountain and subsequently determining an irrigation strategy to maximize olive and oil production. Defined the most appropriate altitude of fog water capture, water was used rationally according to the needs of the olive tree in production. The olive harvest increased from 0.3 to 6.5 kg per tree, 24% (wet weight) oil olive yield was obtained, whose functional characteristics stand out due to the high content of antioxidant components.

Acknowledgments

Proyect PYT-2016-0765 of the Competitiveness Innovation Fund of the Antofagasta region (FIC-R Antofagasta) and Foundation for Agricultural Innovation (FIA).

WMU03-A: ZeBriDi: A new disruptive technology for Zero Brine Discharge in saltwater desalinization

Sebastián Vera[1], Estefanía Bonnail[2], T. Ángel DelValls[1,3]

[1] *Indicum Life S.L., El Puerto de Santa María, 11500. Cádiz, Spain.*

[2] *Centro de Investigaciones Costeras de la Universidad de Atacama (CIC-UDA), Copiapó, Chile.*

[3] *Environmental Science and Technology Department, University of Santa Cecilia, Santos, Brazil.*

Presenting author's email: estefania.bonnail@uda.cl

Desalination of seawater, throughout reverse osmosis, has become a viable option to meet primarily domestic and industrial needs in Chile. This process involves removing salt from seawater to obtain freshwater with quality enough for different uses, and a highly salt concentrate waste stream termed brine. This waste is normally returned to the ocean causing, among other impacts, changes in salinity and temperature, oxygen depletion and stress to local aquatic ecosystems. The Zero Brine Discharge (ZeBriDi) technology is an ecological liquid purification by distillation plant for the separation of solids dissolved in the liquid by accelerating it, with no rejection of the liquid material. It can be described as ecological (solved environmental problems associated to brine discharges, with null CO2 emissions, use of renewable energy), profitable (no costly pretreatments) technology able to produce two sub-products from brine: drinkable freshwater and commercial salt. This plant supposes a newly technological solution coupled (or not) to desalination plants to reduce to zero the ecological impacts associated to brine discharges. Also, it is a promising technology for desalinizing saltwater itself.

Acknowledgments

Authors thank to Comunidad Autónoma Región de Murcia, grant 264/2018.

Poster Presentations

WMUP01: Evaluation of coagulation-flocculation-sedimentation process for the treatment of wastewater generated by oyster culture in the Coquimbo region

Antonella Cossio R.[1,2,3], Denisse Duhalde S[1], Adriana C. Mera.[1,2,3]

[1]*Minning Department, University of La Serena, La Serena Chile.*

[2]*Multidisciplinary Research Institute in Science and Technology, GIMEGA, University of La Serena, La Serena Chile.*

[3]*Chemistry Departament, University of La Serena, La Serena Chile.*

Presenting author's email: acossio@alumnosuls.cl

Currently, Tongoy (Coquimbo, Chile) is the largest producers of oysters in Chile (~70% of the national production). However, the wastewater generated by washing the meshes used in the crop contains high levels of dissolved organic matter. However, one company of region is interested in improving the treatment of wastewater generated. Nowadays, this company use a treatment that have three steps: (1) sedimentation, (2) oxidation and (3) dilution. However, this process is not effective, because water treated is use on irrigation of Eucalyptus plantation. Nevertheless, Eucalyptus not present an effective growth, because water treated has high concentration of salinity and conductivity Then, this industry need to test other treatment for wastewater. In this study, a treatment that include coagulation, flocculation and sedimentation process, will be teste. Variables such as dose of coagulation agent (alum or ferric chloride), agitation speed and settling time, will be evaluate. The application of this physicochemical treatment will contribute to use less fresh water, reduce the carbon footprint, decreases pollution in ground water and air in the Coquimbo region.

Acknowledgments

The authors would like to thank DIDULS PR17511 No. 1020102020910 and the National Commission for Scientific and Technological Research (CONICYT-Chile) by: FONDECYT initation 2017 No. 11170431.