



AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2016

Turno de acceso general

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Referencia: RYC-2016-20211

Área Científica: Tecnología Química

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Título:

Removal of organic pollutants in industrial effluents using photoprocesses, bioprocesses and membrane processes: comparative study and modelling

Resumen de la Memoria:

My research line has been focused in the study of biotreatments for pollutant phenolic removal from effluents, starting with my Undergraduate Final Project "Kinetics of phenol polymerization: application to immobilized horseradish peroxidase". In this work, covalent immobilization of horseradish peroxidase to a porous glass support of controlled pore size (PG 75-400) was carried out. Besides, a simplified kinetic model was successfully applied to the system immobilized horseradish peroxidase/4-chlorophenol/hydrogen peroxide. I followed with this topic with my Doctoral Thesis "Application of continuous reactors with immobilized peroxidase and continuous reactors with ultrafiltration module to the removal of 4-chlorophenol". Along the Doctoral Thesis, studies in discontinuous tank reactor have been carried out, and a kinetic model that extends the reaction cycle of peroxidase from the initial substrate to the products obtained in the reaction has been elaborated. The model parameters were calculated by using software developed in Visual Basic language with this purpose. The immobilized derivatives have been tested in continuous tank and fluidized bed laboratory reactors and in a continuous tank reactor associated to an ultrafiltration membrane module, obtaining elimination percentages of phenolic compounds close to 100%. Model reactors have been developed for all configurations of continuous reactors.

Looking for new alternatives that avoid some of the disadvantages such as enzyme deactivation, during my postdoctoral stay in Pollution Research Unit of Edinburgh Napier University I worked in the Research Project "Study of photooxidation processes of phenolic compounds with excimer lamp technology".

My research was mainly focused in the combined use of ultraviolet radiation (UV) from excimer lamps and strong oxidizers chemical agents in discontinuous reactors, which constitutes a type of advanced oxidation processes (AOPs). The good results obtained with these lamps in the first works with chlorophenols indicate that it can be an appropriate treatment for more pollutants.

After my postdoctoral stay the Research Group of Murcia University incorporated the alternative of photoprocesses as a new research line and during my reincorporating postdoctoral grant of Saavedra Fajardo program I studied the ability of removal of recalcitrant organic pollutants, mainly phenols, anilines and dyes, by membrane technology (nanofiltration and reverse osmosis) and through photodegradation processes based on excimer barrier discharge lamps.

Due to my experience in the different technologies for removing organic pollutants, since 2012 to 2015 (Juan de la Cierva Program) I studied the "Removal of organic pollutants in industrial effluents using photoprocesses, bioprocesses and membrane processes: comparative study and modelling". Nowadays, I form part of the research project "Development of sustainable bioprocesses to obtain cosmetic ingredients that can be labeled as "natural".

As a consequence of this research activity, I have published 65 papers: 49 JCR journals, receiving 426 cites (H index=13, Scopus). I also have published 1 scientific book, 11 book chapters, 73 communications in international and 14 in national conferences. I have participated in 8 research projects, 1 research contract with private company and 2 international cooperation projects.

Resumen del Currículum Vitae:

After graduating in Chemical Engineering (2003) at the University of Murcia (UMU) with an average mark of 8.38 in the scale from 0 to 10, I worked in a wastewater treatment plant (3 months). I incorporated to Prof. A. Bódalo Research Group with a contract in the research project "Microbial production and enzymatic synthesis of new polymeric esters of food and clinical use derived from oleic acid". After that, I was granted with a FPI fellowship from Foundation Seneca in 2004, starting my PhD in a project related to application of continuous reactors with immobilized peroxidases to the 4-chlorophenol removal, under the supervision of Prof. A. Bódalo and Prof. J.L. Gómez. I have carried out two Masters related with my knowledge area and two short stays in the prestigious groups of Prof. K.E. Taylor at University of Windsor, Canada (2 months) about phenol removal from wastewater with soybean peroxidase and hydrogen peroxide and Prof. B. Quilty at Dublin City University, Ireland (3 months) about phenol removal from wastewater with *Pseudomonas putida* CP1. In July 2008 I got my PhD degree in Chemical Engineering (European Doctorate) at UMU, with "sobresaliente Cum Laude" qualification, starting a short stay, previously to my postdoctoral stage, in the Pollution Research Unit of Edinburgh Napier University under the supervision of Prof. N. Christofi (2 months). During the years 2009-2011 I was granted with a postdoctoral scholarship from Foundation Seneca to work with Prof. N. Christofi in the topic of phenolic compounds photooxidation processes with excilamps technology. After finishing it I got a contract for several months in the group of Prof. A. Bódalo and, in December 2011, I got a reincorporating postdoctoral fellowship Saavedra Fajardo from Foundation Séneca to study the removal of organic pollutants with membrane technology and with photoprocesses based on excimer technology, incorporating by this way the technology learned during the postdoctoral stay to the UMU Group. In December 2012 I got, 1st position, a "Juan de la Cierva" contract (3 years) to work in the UMU on removal of organic pollutants using photoprocesses, bioprocesses and membrane processes. In 2015, I got 5th position in "Ramon y Cajal" program. Nowadays, I am teaching in an academy and I am



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associate professor in UMU. I have been member of the assessment committee of 9 Undergraduated Final Projects and 1 Master Thesis. She has published 65 papers: 49 of them in JCR journals, receiving 426 cites (H index=13, Scopus). I have also published 1 scientific book, 11 book chapters and 2 book chapters, 73 contributions in international and 14 in national conferences. I have participated in 8 research projects, 1 research contract with private company and 2 international cooperation projects. I have experience in teaching activities (67.9 credits) and have supervised 26 Undergraduated Final Projects and 2 Master Thesis. I have refereed 43 papers in international journals, forms part of the editorial board of "The Scientific World Journal". I have got different positive assessment from ANECA, in December 2008 of "Profesor Ayudante Doctor", in July 2012 of "Profesor Contratado Doctor" and In July 2013 of "Profesor Titular de Universidad". I am in cooperation with groups from Edinburgh, Russia, Guatemala, Barcelona and Cartagena.



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Título:

Development and intensification of catalytic processes for wastewater treatment

Resumen de la Memoria:

The main line of research developed by the applicant is focused on the development of wastewater treatment processes. Her research interests include advanced oxidation processes (AOPs), mainly Fenton and Catalytic Wet Peroxide Oxidation (CWPO), and Catalytic Hydrodechlorination (HDC). This general line of research will be divided into three sections, which correspond to the research periods of the applicant career and show her growing maturity and independency.

The applicant was firstly focused on the application of those processes seeing from a new perspective. In this sense, she described the complete degradation routes of different pollutants by AOPs, demonstrating that the formation of highly toxic condensation species can occur under substoichiometric conditions. This is crucial for the understanding, design and optimization of AOPs. On the other hand, she improved the activity, stability and recovery of the CWPO catalysts by engineering the active site, developing a new brand of highly active and stable catalysts with magnetic properties. Regarding HDC, the applicant developed bimetallic magnetic catalysts including iron and a noble metal, which were more active and stable than the monometallic counterparts. She also participated assuming a leading role in other projects devoted to the application of AOPs to industrial wastewaters treatment and ionic liquids degradation.

The postdoc period at FAU (Germany) served her to significantly broaden her knowledge on the field of catalysts synthesis. She was mainly focused on the production of well-defined carbon materials, the synthesis of size-controlled nanoparticles (NPs) and the development of novel catalysts containing ionic liquids (SILP and SCILL). The applicant demonstrated the importance to tune the carbon material to selectively modify the activity of the resulting catalyst in liquid-phase hydrogenation reactions, by using carbide-derived carbons. She also found that the stability of Pt catalysts can be remarkably improved by the addition of Ni whereas the activity and selectivity of the PtNi nanoalloy can be also tuned by controlling the NP size. She extended the application of these NPs into the hollow core of the photonic crystal fibers for in-situ catalysis monitoring in collaboration with Max Planck Institute of Light. On the other hand, she significantly boosted the activity of SILP catalysts for the hydroformylation reaction via surface functionalization of the carbon support. Remarkably, she demonstrated that the introduction of hydrophobic ILs represents facile approach to produce high-performing catalysts with an impressive activity enhancement factor in the field of low temperature fuel cells.

Funded by the JdC fellowship, the applicant has started two new lines of research, focusing on the intensification of catalytic processes by groundbreaking concepts, to make them more cost-efficient, sustainable and technically feasible. The development of novel contactor membrane catalytic reactors allows in a unique manner to operate under ambient conditions and continuous flows, optimize H₂O₂ consumption and scale-up easily. She is also exploring the enhancement of CWPO by the use of magnetic induction heating. Focusing the energy directly at the catalyst surface allows the reaction to start faster and with high efficiency, allowing important savings in energy and reagents.

Resumen del Currículum Vitae:

The applicant has been fully dedicated to scientific research for more than eight years. In total, she has been involved in 8 competitive R&D projects (1 European project, 3 National projects and 5 Regional projects). She has also been awarded with several competitive fellowships. Among them, there should be highlighted the FPU PhD (2008-0092) and Juan de la Cierva-Incorporación (1st position in Chemical Technology area, IJCI-2014-19427) fellowships. Her scientific production encompasses 32 international peer-review JCR publications (88% Q1 journals), 1 journal cover, 2 book chapters (1 National and 1 International) and 36 contributions to conferences (23 International and 13 National). She accumulates 365 citations. Her resulting cumulative impact factor is 160. On the other hand, she is the first author of a National patent (another one is in preparation) and so far she has collaborated with up to 13 companies.

The research trajectory of the applicant has a clear international character. She has stayed in total 2 years abroad. She completed two 3-month stays in CUTEC Institute (Germany, pre-doctoral) and Aveiro University (Portugal, post-doctoral), both funded by UAM travel scholarships. Afterwards, she took up a post-doctoral research position for 18 months (with a contract funded by the FP7-EU project) at FAU (Germany). Based on those fruitful stays, she has published 10 international peer-review JCR papers which include international co-authors.

Other important merits of the applicant include the efforts devoted to disseminate research and her teaching experience. Some of her relevant findings have appeared in different media (Boletín Madrid (CM), UAM Gazette, iAgua, etc.). On the other hand, she accumulates



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an important teaching experience with more than 200 hours in the field of Chemical and Environmental Engineering. She has also given specialized seminars to Master and B.Sc students at different institutions (UAM (2), URJC (1), FAU (1) and Aveiro University (1)). She is current coordinator of the subject "Engineering Laboratory" in the B.Sc in Chemical Engineering. Furthermore, thus far she has attended 11 courses focused on creative learning and innovative teaching. It is noteworthy to mention that she obtained the positive assessment by the ANECA as "Profesor Ayudante Doctor" and as "Profesor Contratado Doctor" in June 2013 and October 2016, respectively.

The applicant has proved strong motivation for a research career and independency. She is the first author of 65% of her publications. It is also important to mention that, among her contributions to conferences, she gave 2 invited talks. She has supervised 5 Master Thesis in Chemical Engineering at different institutions (2 at UAM, 2 at UPM and 1 at FAU) and 12 Final Degree Projects of the B.Sc in Chemical Engineering and B.Sc in Environmental Sciences at UAM. The applicant has also supervised a short-term (3 months) stay of a German PhD student. She has also worked as R&D project evaluator (National Agency for Scientific and Technical Promotion of Argentina). Furthermore, she acts as regular reviewer of 50 international journals (41 of them JCR journals), with more than 120 works revised since 2012. Along her research career, the applicant has prepared several project proposals to different funding agencies. It should be highlighted the recently submitted ERC-Starting grant 2017.



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Título:

Advanced catalysts for efficient and cost-effective fuel cells and batteries

Resumen de la Memoria:

The scientific career of David Sebastián del Río, developed in several research centers and universities of Spain, Italy and Canada, represents a highly innovative contribution to the fields of Energy, Chemical Engineering, Catalysis and Electrochemistry. The different research activities of the candidate include the development of novel electrocatalysts and components for fuel cells, batteries and other electrochemical processes, the production and characterization of carbon nanostructures and the investigation of catalysts for application in hydrogen storage systems.

In the period 2005-2006 the applicant investigated the hydrogen storage based on liquid organic hydrides, carried out at the Instituto de Carboquímica (ICB) belonging to CSIC. The investigation was awarded in the "VI Certamen Arquímedes" in December 2006. He also received other awards derived from this work (Caja España, Fundación Mapfre).

In 2007-2011, the candidate carried out his PhD Thesis at CSIC-ICB. The main results were the optimization of carbon nanofibers properties and their study as electrocatalytic support to enhance fuel cell performance and durability. During the Thesis period, he enjoyed three pre-doc stages (total 7 months), one in 2008 at the Universidad de La Laguna (ULL), and two in 2009 and 2010 at Istituto di Tecnologie Avanzate per l'Energia (ITAE) belonging to CNR in Italy, where he acquired skills in electrochemistry and electrocatalysis.

From 2011 to 2013, he extended his research experience in the functionalization of carbon materials with heteroatoms (N, S) during 21 months at CSIC-ICB, including a post-doc short stage at CNR-ITAE in 2011, where his interests were focused on electrocatalyst durability.

In the period 2013-2016 the applicant moved to Italy, at CNR-ITAE, where he worked under a post-doc and a senior CNR contract (45 months). In November 2013 he did a short stage at Institut National de la Recherche Scientifique (INRS) in Quebec, Canada, where he started a research line regarding non-noble metal catalysts based on Ta and Zr on graphene. His research as post-doc in Italy concerned mainly: (a) polymer electrolyte fuel cells: electro-catalysis, membranes and performance evaluation; (b) metal-air batteries electrodes: carbon supports for the positive electrode; (c) electrochemical conversion of CO₂ into short-chain organic molecules. The applicant was also involved in research activities regarding dye-sensitized solar cells and vanadium redox flow batteries. All of the above has been carried out thanks to the development of an extensive network of collaborative research with foreign institutions, leading to a significant number of scientific contributions.

Nowadays the researcher works at CSIC. There are great perspectives to improve the cost-efficiency and durability of electrochemical energy devices like fuel cells and advanced batteries. In the research line presented herein, the investigation of advanced carbon materials (e.g. graphene) hybridized with stable metal oxides and combined with new non-noble metal formulations, together with the candidate's experience in the field, will lead to significant advances and contributions in the fields of energy conversion, electrochemistry and catalysis. His currently active collaboration in several research lines broadens the probabilities of success.

Resumen del Currículum Vitae:

Scientific contribution of the candidate: Dr. Sebastián has authored 50 publications in high impact factor journals (84% in JCR journals, 40% as first or corresponding author, plus other 6 recently submitted). According to Scopus, his JCR publications are distributed in subject areas as follows: Chemistry (22.8%), Chemical Engineering (19.8%), Energy (18.8%), Physics and Astronomy (11.9%), Engineering (9.9%), Materials Science (8.9%), Environmental Science (6.9%) and others (1.0%). He is also first author of a book chapter (Nova Publishers). The publications have been cited more than 580 times with h-index 15 (Scopus). 57% of the JCR articles are in Q1 journals in their respective fields (the rest is Q2). He has 69 contributions to international conferences mainly, 1 invited (Korea 2016) and 46% as oral presentations.

Participation in international activities: Dr. Sebastián carried out 5 stays abroad: 4 months predoc in Italy, CNR (2 stays), 1 month postdoc in Canada, INRS, and 45 months postdoc in Italy, CNR (2 stays). He participated in 4 EU-FP7 research projects, leading the activities of 2 tasks while being postdoc in Italy. He actively collaborates with USA (University of New Mexico), Canada (INRS), Mexico (UNAM), Brazil (USC) and other EU countries, as reflected in his publications. In particular, he established contact and headed a fruitful collaboration with the University of New Mexico in USA, and started a new research line in INRS in Canada. He has participated in two bilateral projects (Spain/Italy 2012 and Italy/Canada 2013). He is involved in several EU networks of collaboration (Free-Cats, BloW-Up).



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Other CV merits: First award 2006 Certamen Arquímedes (former Ministry of Education and Science) and first award by a private bank (Caja España) in renewable energies. CSIC-I3P 4 years grant for PhD studies. Frequent reviewer of more than 20 high impact factor journals. Guest editor of two special issues in JCR journals. Invited to 3 lectures in high schools and a seminar in Politecnico di Torino (Italy). Teacher of a short course in Italy about hydrogen technologies. Invited to the evaluation committee of 2 PhD Thesis (one as president and one as reserve).

Capacity of the candidate to lead his research line: He is currently supervising two PhD students, and has supervised six final degree projects in B.Sc. and M.Sc. in Chemical Engineering carried out within the Instituto de Carboquímica and the Universidad de Zaragoza. The candidate is first or corresponding author of 40% of his research papers. He has lead two important tasks in EU R&D projects of the FP7.



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Referencia: RYC-2016-19347

Área Científica: Tecnología Química

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Título:

Environmental friendly technologies for water management and production of sustainable fuels

Resumen de la Memoria:

The background of the candidate LMPM is in Chemical and Environmental Technology. Her main research interests focus on nano- and macro-structured materials, with major applications in Environmental Catalysis, Membrane Technology and more recently Energy storage and conversion.

During her PhD in Spain (University of Jaén) and France (CNRS-Institut IRCELYON), the candidate gained research experience in the preparation and characterization of advanced activated carbons as adsorbent for the removal of organic pollutants from aqueous solutions and simulation modeling. She has had a long-term interest on the field of Environmental Catalysis, so in order to gain skills in these disciplines, she joined the Associate Laboratory (LSRE/LCM @ University of Porto, Portugal) at the end of 2010 hired within the framework of European FP7 project (Clean Water). In the frame of this project the candidate carried out several stays in research centers of Greece, Slovenia and USA and co-authored several articles with them in the field of photocatalytic water treatment using innovative carbon-based materials. In February of 2013, she started a Post-Doctoral grant in the area of solar driven advanced oxidation processes (AOPs) at the Faculty of Engineering of the University of Porto (FEUP). During this time, she acquired a long experience in the development of nanostructured catalysts and in designing and assembling catalytic reaction systems, contributing with major advancements in photocatalytic water treatment technology. Since June 2015 (until May 2020) she was hired as Associate Researcher at FEUP under Investigator FCT 2014 programme for a 5-year contract, becoming an independent researcher in the field of Clean Energies where she launched a new research line on photocatalytic conversion of CO₂ by using sunlight energy. LMPM has expertise in the development of sustainable nanostructured catalysts, mostly based on carbon materials (e.g., carbon nanotubes, graphene, fullerenes and nanodiamonds) for photocatalysis and other AOPs (including catalytic wet air oxidation, photo-Fenton and ozonation). Her most recent research interest are in the field of carbon based- membranes for water and air treatment and Energy and storage conversion (e.g., dye-sensitized solar cells and Photocatalytic CO₂ conversion). In 2015, she obtained a Research Project funded by Fundação para a Ciência e a Tecnologia that, together with the support by the European Regional Development Fund (NORTE-01-0145-FEDER-000006), enabled her research team to grow, leading to the execution of many experiments with relevant results. She is the co-advisor of one PhD and one MSc focused on the topics: Graphene-based catalytic membranes for water treatment and CO₂ conversion to solar fuels. As a result of different research training internships and the participation in the frame of a European FP7 Project, LMPM has established several contacts. She closely collaborates with Dr. G. Romanos (NCSR Demokritos, Athens, Greece) in the development of graphene membranes for gas and vapor separation and with Dr. K. Kočí (University of Ostrava, Czech Republic) on the mechanism of photocatalytic reduction of CO₂, among others. LMPM also collaborates with a spin-off company (Adventech), a company with expertise in the treatment of industrial wastewaters and gaseous effluents in the industrial sector.

Resumen del Currículum Vitae:

LMPM (Associate Researcher) received her Ph.D (Environmental Chemistry @ 2010, Cum Laude and International Mention) from the University of Jaén (Spain) in collaboration with the University of Lyon (France). She joined at the Faculty of Engineering, University of Porto (FEUP), Portugal in 2010 hired within the framework of European FP7 project (Clean Water). In 2012, she was granted with a Postdoctoral fellowship from the Fundação para a Ciência e a Tecnologia (FCT) in Portugal. In 2015, she became Associate Researcher, after she was selected in the very competitive FCT Investigator Programme call for a 5-year at FEUP, where she launched a research line on photocatalytic conversion of CO₂ to solar fuels.

She has published 37 papers in international peer reviewed ISI indexed journals (plus 3 under review and many others under preparation) which have been cited more than 800 times and holds an h-index of 18 (ISI, January 2017). The two most cited papers have received more than 200 citations. She is the first or corresponding author of 16 of her papers and 32 were published independently from the PhD supervisor. More of the papers were published in journals within 25% of the highest impact factor in their area of knowledge and 9 of them in Applied Catalysis B: Environmental, (1 top journal in the category of: Engineering, Environmental; ISI Web of Knowledge). She has written 4 book chapters, been guest editor of volumes on specific collections and reviewer of scientific journals. She also co-authored 3 publications in a peer reviewed national journals, 2 international journal cover and more than 70 communications in conference proceedings, resulting from 5 invited lectures and from 30 oral and 45 poster presentations (3 of them as winner of best poster communication). She also published some works and performed public demonstrations on popular science for young people. She has supervised 3 MSc and several temporary visiting students at FEUP and currently, she is co-supervising 1 PhD and 1 MSc student. She coordinates 1 project (Photocatalytic membranes for CO₂ conversion to hydrocarbon chemical fuels@ IF/01248/2014), participates as team member in 2 project supported by the European Regional Development Fund (NORTE-07-0124-FEDER-000015 and NORTE-01-0145-FEDER-



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000006) and in the preparation of a ERC starting grant as PI (ERC-2017-STG_2DMAT4FUEL, under evaluation). She has already participated as team member in other 10 projects including the European FP7 project "Clean Water". She is member of the both COST Action ES1403: "New and emerging challenges and opportunities in wastewater reuse" and Red CYTED Iberoamericana (TRITÓN-P315RT0027). At FEUP, she has been lecturing in the courses of Integrated Master in Chemical Engineering and Integrated Master in Environmental Engineering, both awarded the international EUR-ACE (European quality label for engineering degree programmes). She has chaired and collaborated on the organization of several national and international meetings and other events for dissemination of science to the society as the "European Ph.D. School in Advanced Oxidation Processes" (July 2017). She has acted as member of several scientific boards of doctoral theses and as evaluator of research projects in national calls. In 2015, she received scientific Prize from FEUP recognition for her contribute to scientific research.