

Dr. James A. Behan, Ph.D.

PROFILE

- Marie Skłodowska-Curie Fellow at Université de Rennes 1. Current research focuses on bioelectrochemistry and biogenic production of nanoparticle catalysts.
- Since 2016, 16 publications (7 first or joint first author, 2 corresponding author) in peer-reviewed journals; 1 peer-reviewed book chapter in electrocatalysis of carbon electrode materials; 7 oral and 6 poster communications; h-index = 9.
- Expert in electrochemistry, electrocatalysis, particularly the oxygen reduction reaction, carbon nanomaterials, synthesis and characterisation of nanomaterials and nanomaterial surface-biomolecule interactions.
- Experienced lecturer and scientific communicator with years of chemistry teaching and lecturing experience at university level and a strong commitment to scientific outreach.

EDUCATION

2020	Diploma in Python Programming DISTINCTION <i>CCT College Dublin</i>
2014 – 2018	PhD in Chemistry School of Chemistry <i>Trinity College Dublin</i>
2016 – 2017	Certificate in Statistics DISTINCTION School of Computer Science and Statistics <i>Trinity College Dublin</i>
2010 – 2014	Bachelors in Chemistry FIRST CLASS HONORS AND GOLD MEDALIST School of Chemistry <i>Trinity College Dublin</i>

SUCCESSFUL GRANTS

2023 – 2024	Maimonide Fellowship <i>French Government & Israeli Government</i>
2022 – 2023	Ulysses Fellowship <i>French Government & Irish Research Council</i>
2022	Marie Skłodowska-Curie BIENVENUE Fellowship <i>European Commission & Region Bretagne</i>
2020	Make Our Planet Great Again (MOPGA) Fellowship <i>Government of France</i>
2020 – 2021	Postdoctoral Fellowship Award <i>Irish Research Council</i>
2014	Postgraduate Scholarship <i>Irish Research Council</i>
2013	Postgraduate Research Bursary <i>Royal Society of Chemistry</i>

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WORK EXPERIENCE

CURRENT, FROM JAN 2022
Institut des Sciences Chimiques de Rennes, Université de Rennes 1

Marie Skłodowska-Curie Fellow

My current research project is entitled "BioNanoCat: Biogenic Nanoparticles Derived from Bacterial Biofilms for Electrocatalysis." Working at the Institut des Sciences Chimiques de Rennes with Dr. Frédéric Barrière, my research focuses on the application of biofilms of exoelectrogenic bacteria as 'living factories' for the formation of biogenic nanoparticles/nanocatalysts for catalytic applications. Bacteria possess a plethora of defense mechanisms against the presence of toxic metal ions in their environment, including the capacity to bind ions at their surface and reduce them to form nanoparticles. This provides possible avenues of biosynthesis of metal nanoparticle-based catalysts for important processes, such as the oxygen reduction and hydrogen evolution reactions.

APR 2019 – NOV 2021
Centre for Bio-Nano Interactions
Postdoctoral Fellow

My first postdoctoral fellowship project was in the area of biological system - nanoparticle interactions. With Prof. Kenneth Dawson at the Centre for BioNano Interactions (CBNI) at University College Dublin, I worked at the interface of chemistry and biology in nanosynthesis, especially of ligand-decorated nanoparticles for biological applications. My project, which was funded by the Irish Research Council, focused on protein-decorated nanoparticle interactions with target receptors *ex-situ*. This field has important implications for nanomedicine, as drug delivery and diagnostic technologies are increasingly based on the use of nanoparticle-based formulations to target specific cells.

SEPT 2014 – SEPT 2018
School of Chemistry, Trinity College Dublin
PhD Student

My PhD project was carried out under the supervision of Prof. Paula E. Colavita at Trinity College, Dublin. This project focused on the synthesis and characterisation of carbon nanomaterials for applications in electrocatalysis and electroanalysis. I focused specifically on nitrogen doping of carbon scaffolds and its effects on the oxygen reduction reaction, with a secondary focus on interfacial modifications of carbon electrodes for anti-biofouling applications and the analysis of biologically-relevant redox species such as dopamine and other catechols. Electrochemical properties were correlated to carbon nanostructure using a combination of spectroscopic techniques including infrared spectroscopy, x-ray photoelectron spectroscopy and spectroscopic ellipsometry. My thesis was titled *Electrochemical probing of the nanostructure of non-crystalline nitrogenated carbon materials for electrocatalysis*.

School of Pharmacy, Trinity College Dublin
Adjunct Lecturer in Physical Chemistry

In parallel with the final year of my PhD, I took on a temporary post as a lecturer in the School of Pharmacy, Trinity College Dublin. Here I was tasked with delivering a lecture series (3h/week) in physical chemistry for pharmacy students, focused mainly in the areas of molecular interactions, thermodynamics and chemical kinetics. I prepared the lecture series in collaboration with the course coordinator, Prof. Eduardo Ruiz-Hernandez, set the final exam and defined the marking scheme for the course.

AREAS OF EXPERTISE

ELECTROCHEMISTRY	Electrocatalysis, Microbial Fuel Cells, Fundamental Kinetic Studies, Supported Metal Catalysts, Oxygen Reduction Reaction
CARBON MATERIALS	Amorphous Carbons, Nitrogen-Doped Carbon, Carbon Supports in Electrocatalysis
CHARACTERISATION	XPS, UV-Vis Spectroscopy, IR Spectroscopy, AFM, Ellipsometry, TEM, SEM, Raman Spectroscopy
INTERFACES	Covalent Modification of Nanomaterials, Biofilms, Receptor-Nanoparticle Interactions, Quartz Crystal Microbalance

AWARDS

2022	EuroScience Open Forum Poster Prizewinner <i>Euroscience Open Forum Satellite Event, Leiden</i>
2022	Laureate of AMI Emergence Programme <i>Technopole de Rennes</i>
2012-2017	Full Academic Scholarship Award <i>Trinity College Dublin</i>
2016	Young Student Award for Best Presentation <i>European Materials Research Society Fall Meeting</i>
2016	Teaching Award in Practical Chemistry <i>School of Chemistry, Trinity College Dublin</i>
2014	Gold Medal in Natural Sciences - Chemistry <i>School of Chemistry, Trinity College Dublin</i>
2013	Dr George A. Lonergan Prize in Chemistry <i>School of Chemistry, Trinity College Dublin</i>
2011	Billy Robertson Memorial Prize in Biology <i>School of Chemistry, Trinity College Dublin</i>

REFERENCES

Dr. Paula E. Colavita

POSITION	Professor
EMPLOYER	Trinity College Dublin
EMAIL	colavitp@tcd.ie

Dr. Frédéric Barrière

POSITION	Professor
EMPLOYER	Université de Rennes 1
EMAIL	frederic.barriere@univ-rennes1.fr

Dr. Kenneth Dawson

POSITION	Professor
EMPLOYER	University College Dublin
EMAIL	kenneth.a.dawson@cbni.ucd.ie

PUBLICATIONS

- [1] Timothé Philippon, Fatima-Zahra Ait-Itto, Alicia Monfort, Frédéric Barrière, and James A. Behan. Fe(III) oxide microparticles modulate extracellular electron transfer in anodic biofilms dominated by bacteria of the *Pelobacter* genus. *Bioelectrochemistry*, 151:108394, June 2023.
- [2] Aisling Fleming, Lorenzo Cursi, James A. Behan, Yan Yan, Zengchun Xie, Laurent Adumeau, and Kenneth A. Dawson. Designing Functional Bionanoconstructs for Effective *In Vivo* Targeting. *Bioconjugate Chemistry*, 33(3):429–443, March 2022.
- [3] Emily Sheridan, Silvia Vercellino, Lorenzo Cursi, Laurent Adumeau, James A Behan, and Kenneth A Dawson. Understanding intracellular nanoparticle trafficking fates through spatiotemporally resolved magnetic nanoparticle recovery. *Nanoscale Advances*, 3(9):2397–2410, 2021.
- [4] James A. Behan, Eric Mates-Torres, Serban N. Stamatina, Carlota Domínguez, Alessandro Iannaci, Karsten Fleischer, Md Khairul Hoque, Tatiana S. Perova, Max García-Melchor, and Paula E. Colavita. Untangling Cooperative Effects of Pyridinic and Graphitic Nitrogen Sites at Metal-Free N-Doped Carbon Electrocatalysts for the Oxygen Reduction Reaction. *Small*, 15(48):1902081, November 2019.
- [5] James A. Behan, Adam Myles, Alessandro Iannaci, Éadaoin Whelan, Eoin M. Scanlan, and Paula E. Colavita. Bioinspired electro-permeable glycans on carbon: Fouling control for sensing in complex matrices. *Carbon*, 158:519–526, March 2020.
- [6] James A. Behan, Serban N. Stamatina, Md Khairul Hoque, Guido Ciapetti, Federico Zen, Leticia Esteban-Tejeda, and Paula E. Colavita. Combined Optoelectronic and Electrochemical Study of Nitrogenated Carbon Electrodes. *The Journal of Physical Chemistry C*, 121(12):6596–6604, March 2017.
- [7] James A. Behan, Alessandro Iannaci, Carlota Domínguez, Serban N. Stamatina, Md Khairul Hoque, Joana M. Vasconcelos, Tatiana S. Perova, and Paula E. Colavita. Electrocatalysis of N-doped carbons in the oxygen reduction reaction

as a function of pH: N-sites and scaffold effects. *Carbon*, 148:224–230, July 2019.

- [8] James A Behan, Md Khairul Hoque, Serban N Stamatina, Tatiana S Perova, Laia Vilella-Arribas, Max García-Melchor, and Paula E Colavita. Experimental and computational study of dopamine as an electrochemical probe of the surface nanostructure of graphitized N-doped carbon. *The Journal of Physical Chemistry C*, 122(36):20763–20773, 2018.
- [9] James A. Behan, Filip Grajkowski, Dilushan R. Jayasundara, Laia Vilella-Arribas, Max García-Melchor, and Paula E. Colavita. Influence of carbon nanostructure and oxygen moieties on dopamine adsorption and charge transfer kinetics at glassy carbon surfaces. *Electrochimica Acta*, 304:221–230, May 2019.
- [10] Carlota Domínguez, James A Behan, and Paula E Colavita. Electrocatalysis at nanocarbons: Model systems and applications in energy conversion. *Nanocarbon Electrochemistry*, pages 201–249, 2020.
- [11] Md Khairul Hoque, James A Behan, Serban N Stamatina, Federico Zen, Tatiana S Perova, and Paula E Colavita. Capacitive storage at nitrogen doped amorphous carbon electrodes: Structural and chemical effects of nitrogen incorporation. *RSC advances*, 9(7):4063–4071, 2019.
- [12] Md Hoque, James A Behan, James Creel, James G Lunney, Tatiana S Perova, Paula E Colavita, et al. Reactive Plasma N-Doping of Amorphous Carbon Electrodes: Decoupling Disorder and Chemical Effects on Capacitive and Electrocatalytic Performance. *Frontiers in chemistry*, page 1020, 2020.
- [13] Alessandro Iannaci, Adam Myles, Thomas Flinois, James A. Behan, Frédéric Barrière, Eoin M. Scanlan, and Paula E. Colavita. Tailored glycosylated anode surfaces: Addressing the exoelectrogen bacterial community via functional layers for microbial fuel cell applications. *Bioelectrochemistry*, 136:107621, December 2020.
- [14] Adam Myles, James A Behan, Brendan Twamley, Paula E Colavita, and Eoin M Scanlan. Spontaneous aryldiazonium grafting for the preparation of functional cyclodextrin-modified materials. *ACS Applied Bio Materials*, 1(3):825–832, 2018.
- [15] Joana M Vasconcelos, Federico Zen, Serban N Stamatina, James A Behan, and Paula E Colavita. Determination of surface ζ -potential and isoelectric point of carbon surfaces using tracer particle suspensions. *Surface and Interface Analysis*, 49(8):781–787, 2017.
- [16] Federico Zen, M Daniela Angione, James A Behan, Ronan J Cullen, Thomas Duff, Joana M Vasconcelos, Eoin M Scanlan, and Paula E Colavita. Modulation of protein fouling and interfacial properties at carbon surfaces via immobilization of glycans using aryldiazonium chemistry. *Scientific reports*, 6(1):1–10, 2016.
- [17] Federico Zen, Vasilios D Karanikolas, James A Behan, Jenny Andersson, Guido Ciapetti, A Louise Bradley, and Paula E Colavita. Nanoplasmonic sensing at the carbon-bio interface: Study of protein adsorption at graphitic and hydrogenated carbon surfaces. *Langmuir*, 33(17):4198–4206, 2017.

Submitted articles at time of writing: Behan, J.A., Adumeau, L., Dawson, K.A. et al. Quartz Crystal Microbalance method to measure nanoparticles-receptor interactions and evaluate nanoparticle design efficiency, *JACS Au* (2022).

COMMUNICATIONS

Oral Communications at Conferences

As speaker:

- 26 September 2022 - XVIIth Colloquium of the Groupe Français de Bioelectrochimie, Saint-Dié-des-Vosges, «Tailoring Carbon Nanomaterial Interfaces for Electrochemical applications in Catalysis, Electroanalysis and Microbial Fuel Cells» **Behan, J.A.*** Myles, A.; Ianacci, A.; Barrière, F.; Colavita, P.E.
- 30 May – 3 June 2022 -European Materials Research Society Spring Meeting «Tailored Carbon Nanomaterial Interfaces for Electrocatalysis, Electroanalysis and Microbial Fuel Cell Applications» **Behan, J.A.**; Myles, A.; Ianacci, A.; Barrière, F.; Colavita, P.E.
- 04 April 2019 – Centre for BioNano Interactions, University College Dublin, Modification of Carbon Nanomaterials for Energy and Sensing Applications. **Behan, J.A.**; Hoque, M.K.; Stamatina, S.N.; Myles, A.; Garcia-Melchor, M.; Colavita, P.E.
- 02-17 September 2018 - 69th Annual Meeting of the International Society of Electrochemistry, Bologna, Italy- Experimental and Computational Study of Dopamine as an Electrochemical Probe of the Surface Structure of Carbon Surfaces. **Behan, J.A.**; Hoque, M.K.; Grajkowski, F.; Garcia-Melchor, M.; Colavita, P.E.
- 03 Oct 2017 – International Society of Electrochemistry Student Satellite Meeting, Tyndall Institute, Cork, Ireland – Combined Optoelectronic and Electrochemical Characterisation of Nitrogenated Amorphous Carbon Electrodes **Behan, J.A.**; Hoque, M.K.; Stamatina, S.N.; Colavita, P.E.
- 10-12 September 2017 – Electrochem 24th Annual Conference, Birmingham, United Kingdom – Combined Optoelectronic and Electrochemical Study of Nitrogenated Carbon Electrodes **Behan, J.A.**; Hoque, M.K.; Stamatina, S.N.; Colavita, P.E.
- 30 May 2017 – Dublin Chemistry (DubChem) Eli Lily PhD Presentation, University College Dublin, Ireland – Synthesis and combined optoelectronic and electrochemical studies of nitrogenated carbon electrodes Behan, J.A.; Hoque, M.K.; Stamatina, S.N.; Colavita, P.E.

As Co-Author:

- 26 September 2022 - XVIIth Colloquium of the Groupe Français de Bioelectrochimie, Saint-Dié-des-Vosges, «Impact of iron oxide in the development of specific exoelectrogens bacteria in anoxic environment» Ait-Itto, F.Z.; Philippon, T.; Monfort, A.; **Behan, J.A.**; Barrière, F.
- July 2018 – Carbon – Madrid, Spain. "Carbohydrate Coatings for Biofouling Mitigation: Diazonium-based Saccharide coatings for improved electrochemical sensors". Myles, A.; **Behan, J.A.**; Scanlan, E.M.; Colavita, P.E.
- Oct 2017, ISE Satellite Regional Symposium – Tyndall National Institute, Cork, Ireland – Lactose coatings for improved implantable electrochemical sensors. Myles A.; **Behan, J.A.**; Scanlan, E.M.; Colavita, P.E.

- 10-12 September 2017 – Electrochem 24th Annual Conference, Birmingham, United Kingdom «Study of model carbon materials with graphitic-N sites for oxygen reduction reaction» Domingue, C.; **Behan, J.A.**; Hoque, M.K.; Stamatina, S.N.; Vasconcelos, J.M.; Perova, T.; Colavita, P.E.
- May 22-26 2017 – European Materials Research Society Spring Meeting, Strasbourg, France – Bioinspired carbohydrate coatings modulation of protein fouling and interfacial properties at carbon surfaces. Zen, F.; Vasiliou, K.D.; **Behan, J.A.**; Vasconcelos, J. M.; Andersson, J.; Duff, T.; Scanlan, E.M.; Bradley, L.; Colavita, P.E.
- May 22-26 2017 – European Materials Research Society Spring Meeting, Strasbourg, France – Surface modification studies of carbon thin films for applications in carbon-based biodevices Vasconcelos, J.M.; Zen F.; **Behan, J.A.**; Hoque, M.K.; Cullen, R.J.; Colavita, P.E.

Poster Communications

As Presenter:

- 12-13 July 2022 – EuroScience Open Forum Satellite Event, Lieden, Netherlands. Biogenic Nanoparticles Prepared from Bacterial Biofilms for Electrocatalysis **Behan, J.A.**, Ait-Itto, F.; Barrière, F.
- Sept 07-08 2017 – Royal Society of Chemistry Carbohydrate Section Meeting, Trinity College Dublin, Ireland – Anti-Fouling Properties of Lactose-Modified Carbon Electrodes: A Fundamental Study. **Behan, J.A.**; Myles, A.; Ciapetti, G.; Zen, F.; Scanlan, E.M.; Colavita, P.E.
- May 22-26 2017 – European Materials Research Society Spring Meeting, Strasbourg, France – Nitrogen-Incorporated Amorphous Carbon Thin Films with Tuneable Optoelectronic Properties Prepared via DC Magnetron Sputtering **Behan, J.A.**, Stamatina, S.N.; Hoque, M.K.; Ciapetti, G.; Colavita, P.E.
- May 22-26 2017 – European Materials Research Society Spring Meeting, Strasbourg, France – Combined Optoelectronic and Electrochemical Study of Nitrogenated Carbon Electrodes **Behan, J.A.**, Stamatina, S.N.; Hoque, M.K.; Ciapetti, G.; Colavita, P.E.
- Sept 19-22 2016 – European Materials Research Society Fall Meeting, Warsaw, Poland – Nitrogen-Incorporated Amorphous Carbon Thin Films: An Optical and Electrochemical Characterisation **Behan, J.A.**, Stamatina, S.N.; Hoque, M.K.; Ciapetti, G.; Vasconcelos, J.M.; Colavita, P.E.
- July 8 2016 – United Kingdom Surface Analyst Forum Meeting, University College Dublin, Ireland – Optoelectronic and Electrochemical Characterisation of Nitrogenated Amorphous Carbon Thin Film Electrodes **Behan, J.A.**, Stamatina, S.N.; Hoque, M.K.; Ciapetti, G.; Colavita, P.E.

As Co-Author:

- 12 May 2019 – Royal Society of Chemistry Organic Division Regional Meeting, Queen's University, Belfast – Multipurpose Cyclodextrin Grafting: From Crystals to Coatings. Myles, A.; **Behan, J.A.**; Scanlan, E.M.; Colavita, P.E.

- 10-12 September 2017 – Electrochem 24th Annual Conference, Birmingham, United Kingdom – Capacitive Properties of Nitrogen Doped Amorphous Carbon Materials for Electrocatalytic Applications, Hoque, M.K., **Behan, J.A.**, Stamatina, S.N.; Hoque, M.K.; Ciapetti, G.; Colavita, P.E.; Stamatina, S.N.; Zen, F. Colavita, P.E.
- May 22-26 2017 – European Materials Research Society Spring Meeting, Strasbourg, France – Plasmonic sensing of carbon thin films for biological applications. Zen, F.; Vasiliou, K.D.; **Behan, J.A.**; Stamatina, S.N.; Hoque, M.K.; Ciapetti, G.; Colavita, P.E.; Vasconcelos, J. M.; Andersson, J.; Duff, T.; Scanlan, E.M.; Bradley, L.; Colavita, P.E.

TEACHING EXPERIENCE

Lecturing

As outlined above, I worked as an adjunct lecturer in physical chemistry for the School of Pharmacy, Trinity College Dublin, in 2018. This gave me broad experience lecturing to a large audience of around 100 bachelor's students, 3h per week, as well as experience preparing lecture notes, slides, problem sheets, exam questions and marking schemes. I also designed and delivered a lecture and tutorial series aimed at first year undergraduates in chemistry in the 2017-18 academic year with 2 contact hours with 2 groups of students per week for the School of Chemistry. This gave me experience in tailoring courses and teaching styles to weaker students who had no prior experience in chemistry before coming to university. I transferred these skills during my postdoc at the Centre for BioNano Interactions, University College Dublin. There I organised a master class as part of the *Current Trends in Nanomedicine* module for UCD's nanoscience Master's Degree program. The course was organised in collaboration with Prof. Kenneth Dawson, a leading expert in the field of nanomaterial-biological systems interactions. I also set the course assignment and marking scheme and corrected the exam.

Practical Teaching

I was an award-winning laboratory demonstrator in physical chemistry laboratory sessions to hundreds of students (3-6 contact hours/week during entire academic years of 2014-2017). After this experience I continued to organise labs and tutorial sessions: at the Centre for BioNano Interactions I organised workshops for PhD and masters students in experimental design and statistics, graphical representation of data for publication, scientific writing and preparation of scientific talks for thesis defence and international conferences. Most recently in Rennes I have carried out practical laboratory sessions in fundamental electrochemistry with my supervisor, Prof. Frédéric Barrière. I have also been chosen for a vacation for practical laboratory sessions in electrochemistry with Prof. Didier Hauchard at ENSC Rennes for the 2022-23 academic year.

SCIENTIFIC LEADERSHIP

In my present role at the ISCR I supervise one student intern (internship to be completed in March 2023). Along with Prof. Frédéric Barrière I have successfully co-authored two collaborative grants with labs in Ireland and Israel. Our current research is highly interdisciplinary and collaborative with colleagues in Geoscience and Microbiology - I have taken the lead in training post-doctoral colleagues in these disciplines in physical chemistry and

electrochemical methods in our laboratory.

During my doctoral studies I mentored numerous project students and undergraduate visitors to our laboratory. I designed an undergraduate summer project in laboratory research and scientific writing which thanks to my guidance and mentoring resulted in a 2nd year undergraduate intern co-authoring a publication with me in *Electrochimica Acta* (2019).

At the Centre for BioNano Interactions I was the safety officer and oversaw the training and induction of new students into the team. I supervised and guided 6 Ph.D. students in their daily research activities and fully oversaw 1 masters student project (thesis submitted and defended 2020). I was the point of contact for an industrial collaboration between CBNI and Intel Ireland in the area of nanomaterials safety and environmental impact, which involved supervising and advising the project of one industrial PhD student (project to be completed 2023). As a senior group member I also ran workshops in management of data, applied my Certificate in Statistics to teach short classes in statistical analysis and the production of scientific figures for publication which were delivered to the junior members of the research team as a form of training and induction.

OUTREACH

Promoting Science to the Masses

I am a laureate of the AMI Emergence Programme, which is an entrepreneurship and outreach programme designed to train scientists in commercialising their research and communicating its value to policymakers, investors and the general public. As part of this programme I gave a 'pitch' of my work to an audience comprised of investors and local government officials in Brittany. I also participated in the Fête de la Science, an outreach event where I carried out public demonstrations of chemical experiments to schoolchildren and the general public. My presentation (in French) can be viewed [here](#). I have also recently partnered with a chain of montessoris in Rennes to carry out short visits to demonstrate simple science experiments for young children.

During my doctoral studies I was also a volunteer with the Voluntary Tuition Programme, where I taught and mentored second-level students from disadvantaged schools in Dublin City Centre in science and mathematics with free one-on-one lessons every week. The programme also involved short talks to promote a career in STEM fields.

I maintain a blog where I post updates on my current project at <https://www.jamesbehan.net>