

Dr. James A. Behan, Ph.D.

PROFILE

- Marie Skłodowska-Curie BIENVENUE Fellow at Université de Rennes I. Current research focuses on bioelectrochemistry - in particular, the interaction of bacteria with toxic metals for the biogenic production of nanoparticle catalysts
- Since 2016, 14 publications (7 first or joint first author, 1 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 = 8;
- 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, five years of laboratory teaching and continuous involvement in scientific outreach.

EDUCATION

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| 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

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| 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 I
Marie Skłodowska-Curie Fellow

My current research project is entitled "BioNanoCat: Biogenic Nanoparticles Derived from Bacterial Biofilms for Electrocatalysis." Working at the Institut des Science 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.

SEP 2018 – APR 2019
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
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	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] J. A. Behan, F. Grajkowski, D. R. Jayasundara, L. Vilella-Arribas, M. García-Melchor, and P. 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.
- [2] J. A. Behan, M. K. Hoque, S. N. Stamatina, T. S. Perova, L. Vilella-Arribas, M. García-Melchor, and P. 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. Publisher: American Chemical Society.
- [3] J. A. Behan, A. Iannaci, C. Domínguez, S. N. Stamatina, M. K. Hoque, J. M. Vasconcelos, T. S. Perova, and P. 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.
- [4] J. A. Behan, E. Mates-Torres, S. N. Stamatina, C. Domínguez, A. Iannaci, K. Fleischer, M. K. Hoque, T. S. Perova, M. García-Melchor, and P. 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, Nov. 2019.
- [5] J. A. Behan, A. Myles, A. Iannaci, P. Whelan, E. M. Scanlan, and P. E. Colavita. Bioinspired electro-permeable glycans on carbon: Fouling control for sensing in complex matrices. *Carbon*, 158:519–526, Mar. 2020.
- [6] J. A. Behan, S. N. Stamatina, M. K. Hoque, G. Ciapetti, F. Zen, L. Esteban-Tejeda, and P. E. Colavita. Combined Optoelectronic and Electrochemical Study of Nitrogenated Carbon Electrodes. *The Journal of Physical Chemistry C*, 121(12):6596–6604, Mar. 2017.
- [7] C. Domínguez, J. A. Behan, and P. E. Colavita. Electrocatalysis at nanocarbons: model systems and applications in energy conversion. *Nanocarbon Electrochemistry*, pages 201–249, 2020. Publisher: John Wiley & Sons, Inc. Chichester, UK.
- [8] A. Fleming, L. Cursi, J. A. Behan, Y. Yan, Z. Xie, L. Adumeau, and K. A. Dawson. Designing Functional Bio-nanoconstructs for Effective *In Vivo* Targeting. *Bioconjugate Chemistry*, 33(3):429–443, Mar. 2022.
- [9] M. Hoque, J. A. Behan, J. Creel, J. G. Lunney, T. S. Perova, P. E. Colavita, and others. Reactive Plasma N-Doping of Amorphous Carbon Electrodes: Decoupling Disorder and Chemical Effects on Capacitive and Electrocatalytic Performance. *Frontiers in Chemistry*, page 1020, 2020. Publisher: Frontiers.
- [10] M. K. Hoque, J. A. Behan, S. N. Stamatina, F. Zen, T. S. Perova, and P. E. Colavita. Capacitive storage at nitrogen doped amorphous carbon electrodes: structural and chemical effects of nitrogen incorporation. *RSC advances*, 9(7):4063–4071, 2019. Publisher: Royal Society of Chemistry.
- [11] A. Iannaci, A. Myles, T. Flinois, J. A. Behan, F. Barrière, E. M. Scanlan, and P. E. Colavita. Tailored glycosylated anode surfaces: Addressing the exoelectrogen bacterial community via functional layers for microbial fuel cell applications. *Bioelectrochemistry*, 136:107621, Dec. 2020.

- [12] A. Myles, J. A. Behan, B. Twamley, P. E. Colavita, and E. M. Scanlan. Spontaneous aryldiazonium grafting for the preparation of functional cyclodextrin-modified materials. *ACS Applied Bio Materials*, 1(3):825–832, 2018. Publisher: American Chemical Society.
- [13] E. Sheridan, S. Vercellino, L. Cursi, L. Adumeau, J. A. Behan, and K. A. Dawson. Understanding intracellular nanoparticle trafficking fates through spatiotemporally resolved magnetic nanoparticle recovery. *Nanoscale Advances*, 3(9):2397–2410, 2021. Publisher: Royal Society of Chemistry.
- [14] J. M. Vasconcelos, F. Zen, S. N. Stamatina, J. A. Behan, and P. 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.
- [15] F. Zen, M. D. Angione, J. A. Behan, R. J. Cullen, T. Duff, J. M. Vasconcelos, E. M. Scanlan, and P. 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. Publisher: Nature Publishing Group.
- [16] F. Zen, V. D. Karanikolas, J. A. Behan, J. Andersson, G. Ciapetti, A. L. Bradley, and P. 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. Publisher: American Chemical Society.

COMMUNICATIONS

Oral Communications at Conferences

- 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.

Poster Communications

- 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.
- 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
- May 22-26 2017 – European Materials Research Society Spring Meeting, Strasbourg, France – Combined Optoelectronic and Electrochemical Study of Nitrogenated Carbon Electrodes
- Sept 19-22 2016 – European Materials Research Society Fall Meeting, Warsaw, Poland – Nitrogen-Incorporated Amorphous Carbon Thin Films: An Optical and Electrochemical Characterisation
- July 8 2016 – United Kingdom Surface Analyst Forum Meeting, University College Dublin, Ireland – Optoelectronic and Electrochemical Characterisation of Nitrogenated Amorphous Carbon Thin Film Electrodes

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.

Mentoring and Supervision

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 co-authoring a publication with me in *Electrochimica Acta* (2019). At the Centre for BioNano Interactions I trained, supervised and guided 6 Ph.D. students in their daily research activities and fully oversaw 1 masters student project (thesis submitted and defended 2020).

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. I have 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, which aimed at teaching and mentoring second-level students from disadvantaged schools in Dublin in science and mathematics with free one-on-one lessons every week.

I maintain a blog to track the progress of my current project at <https://www.jamesbehan.net>