## Dr. Jerry Alfred Fereiro

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## Profile

My principal research interests lie in the field of bio/molecular electronics and interfacial charge transport. My areas of interest also include surface functionalization, nano-fabrication, low-temperature electronic measurements, surface analysis, and electrochemistry.

During my Ph.D. (with Prof Richard. L McCreery, University of Alberta) I investigated the interaction of light with molecular junctions, measuring the photocurrent spectra and understanding the complex phenomenon of the charge transfer process at the interfaces associated with light-molecule interactions, and the role of molecules in photocurrent generation. During my first postdoc as an Azrieli postdoctoral fellow at the Weizmann Institute of Science (jointly with Profs. David Cahen, Mordechai Sheves & Israel Pecht) I investigated how to control the charge transport (ETp) through solid-state protein junctions by chemically modulating electrode-protein interactions at the interface with a central vision of using proteins as potential building components for future bio-electronic devices. During my second postdoc at the Technical University of Munich (with Prof Marc Tornow, TUM) I investigated the memristive switching behavior of protein junctions.

## Summary of skills

- Experimental bio-physicist with more than ten years of hands-on research experience in the laboratory on various projects, including co-design/built-in instrumentation for different experimental set-up including photocurrent experiments, low temperature(4K) four-probe I-V measurements and Inelastic Electron Scattering Spectroscopy (IETS).
- Completed Graduate Level Teaching course with **GTL-Level 3 Certification** from University of Alberta, Canada. Prepared course module, detailed syllabus, course materials, delivered lectures and conducted exams as part of the GTL training.
- Demonstrated teamwork skills by working as a member of an interdisciplinary team in different countries (Canada, Germany, India, Israel). Acquired communicational and presentational skills by attending various (inter)national conferences and initiated new scientific collaborations with research groups around the globe.
- Served as a member of the "Emergency Response – First Aid and Safety Team" at National Institute of Nanotechnology (NINT-NRC), with certified Standard First Aid, CPR Level C and AED, WHMIS and Laboratory Chemical training.

## Educational qualifications

- **Ph.D. Chemistry (Jan. 2010 - Jul. 2015)**, University of Alberta, Edmonton, Canada.
  Advisor: Prof Richard L. McCreery, Dept. of Chemistry, University of Alberta.
  **Dissertation:** "Photoresponse of Molecular Tunnel Junctions: Converting Photons to charge carriers and probing internal energy levels".
- **M.Sc. Chemistry (Aug. 2007 - Aug. 2009)**, National Institute of Technology-Trichy, India **(Gold medal)**.
  Advisor: Prof Chellapalli Subrahmanyam, Now at Dept. of Chemistry, Indian Institute of Technology-Hyderabad
  **Thesis:** "Synthesis and Characterization of Gold Nanoparticles, Carbon Nano-materials for low-temperature CO oxidation".
- **B.Sc. Chemistry (Aug. 2004 - Jun. 2007)**, Mahatma Gandhi University, Kerala, India **(First Rank)**.

## Research experiences

12/2021– till date **Assistant Professor**
School of Chemistry, Indian Institute of Science Education and Research, Thiruvananthapuram (IISER TVM), Kerala, India.

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| 4/2021– 11/2021 | **Postdoctoral Fellow** |
| Advisor: | Prof. Marc Tornow, Dept. of Electrical & Computer Engineering, Technical University of Munich, Germany. |
| 9/2015 – 3/2021 | **Postdoctoral Fellow** |
| Advisors: | Prof. David Cahen, Dept. of Materials and Interfaces, Weizmann Institute of Science, Israel.<br>Prof. Mordechai Sheves, Dept. of Organic Chemistry, Weizmann Institute of Science, Israel.<br>Prof. Israel Pecht, Dept. of Immunology, Weizmann Institute of Science, Israel. |
| 1/2010 – 6/2015 | **Graduate Student** |
| Advisor: | Prof. Richard L. McCreery, Dept. of Chemistry, University of Alberta, Canada. |
| Mentor: | Dr. Adam Bergren, Research Officer, National Institute for Nanotechnology (NINT), University of Alberta, Canada. |
| 9/2008 – 6/2009 | **Junior Research Assistant** |
| Advisor: | Prof. Chellapalli Subrahmanyam, Dept. of Chemistry, National Institute of Technology-Trichy (NIT)-Trichy, India. Now at Indian Institute of Technology-Hyderabad, India. |
| 5/2008 – 7/2008 | **Indian Academy of Science – Summer fellow** |
| Advisor: | Prof. Javed Iqbal, Director, Institute of Life Sciences, Hyderabad Central University, India. |
| Mentor: | Prof Pinaki Talukdar, now at the Indian Institute of Scientific Educational Research (IISER), Pune. |

## Awards and fellowships

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| 2021-2023 | **Marie Sklodowska-Currie fellowship** under **EurotechPostdoc2** program [highly prestigious fellowship awarded to experienced high-potential researchers] |
| 2021-2022 | Technical University of Munich (TUM), Molecular Electronics Chair Postdoctoral fellowship |
| 2016-2019 | **Azrieli Postdoctoral Fellowship** [Highly prestigious Canada-Israel national-level post-doctoral fellowship – awarded to 5 postdocs/year] |
| 2015-2016 | **Dean of Faculty Postdoctoral Fellowship** [Competitive fellowship awarded to post-doctoral researchers at the Weizmann Institute of Science] |
| 2015-2016 | **Israel's Council of Higher Education Planning and Budgeting Committee (VATAT)** Postdoctoral Fellowship for outstanding postdoctoral researchers. [National level competitive fellowship in Israel] |
| 2012-2015 | Research Assistant Fellowship from Dept. of Chemistry, University of Alberta, Canada. |
| 2009-2010 | **MSc Chemistry Gold medalist** from National Institute of Technology – Trichy (India) for having secured the highest GPA in the Chemistry department, NIT-Trichy. |
| 2009-2010 | **Outstanding MSc student** of the year award by RECAL alumni association NIT-T. [Given to a single student every year for his overall performance in the department]. |
| 2008-2009 | Indian Academy of Science Summer fellow for the year 2009. [Competitive fellowship] |
| 2008-2009 | Indian Institute of Technology-Madras (IIT-M) Summer fellow for the year 2009. [Competitive fellowship] |
| 2008-2009 | MSc Chemistry **First rank award** from National Institute of Technology – Trichy (India) for securing the first rank during 1$^{st}$ and 2$^{nd}$ semester |
| 2007-2008 | **BSc Chemistry Gold medalist** from Mahatma Gandhi University (India) for having secured the highest mark in the university. [Topper among 1080 students] |
| 2002-2003 | Secured **National Talent Search Examination (NTSE) scholarship** conducted by NCRT at 10$^{th}$ grade. [One of the most prestigious secondary level scholarships in India] |

## Teaching experience

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| 2020-2021 | Offered four different lectures to the students of the Technical University of Munich, Germany enrolled for the summer and winter courses in biomolecular electronics. |
| 2018-2019 | Completed an online teaching project named "A window to the future" with the **Davidson Institute of Science Education** at the Weizmann Institute of Science delivering online tutorials and lectures to high school students from Israel, Germany and Switzerland (2018). |
| 2012-2015 | Worked as **Research Assistant** in Dept. of Chemistry, University of Alberta, Canada. |

- Supervised teaching assistants, organized lab courses.
- Carried out examination and evaluation duties assigned by Dept. of Chemistry, University of Alberta, Canada.

2010-2012 **Teaching Assistant**: Assisted in the courses General Chemistry-101, General Chemistry-102 & Advanced Analytical Chemistry Course (304), Dept. of Chemistry, University of Alberta, Canada (> 100 students).

- Supervised undergraduate students (chemistry major) for lab experiments.
- Selected as a best teaching assistant (2011-2012) by student evaluation (General Chemistry-102).

❖ Supervised in total four undergraduate students from different Universities across the globe (Germany, USA and Israel) for international summer projects (two months) organized by the Davidson Institute of Science Education at the Weizmann Institute of Science (2017 - 2019).

## Peer-reviewed scientific publications

**[# corresponding author] [* equal contribution]**

1. Domenikos Chryssikos, Julian M Dlugosch, **Jerry A. Fereiro**, Takuya Kamiyama, Moredchai Sheves, David Cahen and Marc Tornow. "Electronic Transport through organophosphonate-grafted bacteriorhodopsin films on titanium nitride". *IEEE 21st International Conference on Nanotechnology (NANO). 2021,* 389-392.
   **[doi: 10.1109/nano51122.2021.9514351]**
2. **Jerry A. Fereiro#**, Israel Pecht, Mordechai Sheves and David Cahen. "Inelastic electron tunneling spectroscopic analysis of bias-induced structural changes in a solid-state protein junction". *Small. 2021,* Vol. 17, No. 19, *e2008218*.
   **[https:// doi:10.1002/smll.202008218]** [**# corresponding author**]
3. **Jerry A. Fereiro#**, Tatyana Bendikov, Israel Pecht, Mordechai Sheves, David Cahen. "Protein binding and orientation matters: Bias induced conductance switching in mutated azurin junctions". *Journal of the American Chemical Society* ***(JACS)***. 2020, vol. 142, No.45, 19217-19225.
   **[https://doi.org/10.1021/jacs.0c08836]** [**# corresponding author**]
4. Sabyasachi Mukhopadhyay, Karuppannan Sentil Kumar, Cunlan Guo, **Jerry A. Fereiro**, Vineetha Mukundan, Xinkai Qiu, E. Olga, Mordechai Sheves, Chen Xioping, Adam Bergren, Ryan C. Chiechi, Richard L McCreery, Mordechai Sheves, Rupali Reddy Pasula, Sierin Lim, Christian A. Nijhuis, Ayelet Vilan and David Cahen. "Protein-Electrode coupling can dominate efficiency without affecting the mechanism of electronic-transport-results from a cross-lab comparative study of solid-state protein junctions". *iScience.*2020, vol. 23(5), 101099.
   **[https://doi.org/10.1016/j.isci.2020.101099]**
5. Ben Kayser, **Jerry A. Fereiro**, Rajarshi Bhattacharyya, Sidney R Cohen, Ayelet Vilan, Israel Pecht, Mordechai Sheves, David Cahen. "Solid-State Electron Transport via the Protein Azurin is Temperature-Independent Down to 4K". *Journal of Physical Chemistry Letters (****JPCL)***. 2019, vol. 11(1), 144-151.
   **[https://doi.org/10.1021/acs.jpclett.9b03120]**
6. **Jerry A. Fereiro**, Ben Kayser, Ayelet Vilan, Dmitry A. Dolgikh, Rita V. Chertkova, Juan Carlos Cuevas, Linda A. Zotti, Israel Pecht, Mordechai Sheves and David Cahen. "A Solid-state Protein Junction Serves as a Bias-Induced Current Switch". *Angewandte Chemie International Edition* ***(Angew. Chem. Int. Ed)***. 2019, vol. 131,11978-11985.
   **[https:/doi.org/10.1002/anie.201906032] (*Molecular electronics: Hot paper* - Inside back cover page)**
7. Colin Van Dyck, Adam Johan Bergren, Vineetha Mukundan, **Jerry A. Fereiro** and Gino A. DiLabio. "Extent of conjugation in diazonium-derived layers in molecular junction devices by experiment and modelling". *Phys. Chem. Chem. Phys* ***(PCCP)***. 2019, 21, 16762-16770.
   **[https://doi.org/10.1039/C9CP03509E]**
8. **Jerry A. Fereiro**, Gilad Porat, Tatyana Bendikov, Israel Pecht, Mordechai Sheves, David Cahen. "Chemical Modulation of Protein Electrode Interactions Enables Control of the Alignment of Frontier Orbitals in Gold-

Azurin-Gold Junctions". *Journal of the American Chemical Society* ***(JACS)***. 2018, vol. 140, No.41, 13317-13326.
**[https://doi.org/10.1021/jacs.8b07742]**

9. Ben Kayser**,** **Jerry A. Fereiro**, Cunlan Guo, Sidney Cohen, Mordechai Sheves, Israel Pecht, David Cahen. "Transistor Configuration Yields Energy Level Control in Protein-Based Junctions". ***Nanoscale***. 2018, vol. 10, 21712-21720.
**[https://doi.org/10.1039/C8NR06627B]**

10. **Jerry A. Fereiro**, Xi Yu, Juan C. Cuevas, Israel Pecht, Mordechai Sheves, David Cahen. "Resonant tunneling explaining efficient current flow through Azurin". *Proceedings of the National Academy of Sciences* ***(PNAS-USA)***. 2018, vol. 115, No.20, E4577-E4583.
**[https://doi.org/10.1073/pnas.1719867115]** **(*Molecular electronics: Hot paper*)**

11. **Jerry A. Fereiro**, Mykola Kondratenko, Adam J. Bergren, Richard L. McCreery. "Internal photoemission in molecular junctions: Parameters for interfacial parameter determination*". Journal of the American Chemical Society* ***(JACS)***. 2015, vol. 137, No.3, 1296-1304.
**[https://doi.org/10.1021/ja511592s]**

12. **Jerry A. Fereiro**, Adam J. Bergren, Richard L. McCreery. "Direct optical determination of interfacial transport barriers in molecular tunnel junctions". *Journal of the American Chemical Society* ***(JACS)***. 2013, vol. 135, No.26, 9584-9587.
**[https://doi.org/10.1021/ja403123a]**

13. Sayed Y. Sayed*, **Jerry A. Fereiro*,** Haijun Yan, Richard L. McCreery, Adam J. Bergren. "Charge transport in molecular electronic junctions: Compression of the molecular tunnel barrier in the strong coupling regime". *Proceedings of the National Academy of Sciences* ***(PNAS-USA)***. 2012, vol. 109, No.29, 11498-11503.
**[https://doi.org/10.1073/pnas.1201557109]** (***equal contribution**)

14. Prabhakarn A, **Jerry A. Fereiro**, Subrahmanyam Ch. "Esterification of Methacrylic acid with Ethylene glycol over Heteroployacid supported on ZSM-5". *Journal of the Korean Chemical Society*. 2011, vol. 55, Issue 1, 14-18.
**[http://dx.doi.org/10.5012/jkcs.2011.55.1.014]** **(Published during MSc Chemistry)**

## Patents

1. "Bias Induced Conductance Switching in Solid-state Au-Protein-Au Junctions" (Israel Patent Application, **File Number: 278424**)
Inventors: **Jerry A. Fereiro**, Mordechai Sheves, Israel Pecht, David Cahen, Tatyana Bendikov.

## Reviewer role

**Journal referee**: Journal of material chemistry C, Advanced materials, Chemistry a European Journal, Journal of physical chemistry letters and Applied materials and interfaces.

**Project referee**: DFG-grant proposal [2019, 2020]

## Conferences and presentations

2021 **Oral Presentation**: "Molecules(bio) as part of solid-state electronic components"- Technical University of Munich (TUM), Munich, Germany. (via ZOOM).

2021 **Oral Presentation**: "The dependence of charge transport on the orientation of the proteins in a solid-state configuration"- Technical University of Munich (TUM), Munich, Germany. (via ZOOM).

2021 **Oral Presentation**: "A glimpse at future bioelectronics: Proteins as part of solid-state electronic components"- Indian Institute of Scientific Educational Research, Bhopal (IISER-Bhopal), Madhya Pradesh, India (via ZOOM).

2020 **Oral Presentation**: "Protein electronics and its applications"- Indian Institute of Scientific Educational Research, Pune (IISER-Pune), Maharashtra, India (via ZOOM).

2020 **Oral Presentation**: "Controlling resonant transport via bio-molecular junctions" – Indian Institute of Science (IISC), Inorganic and Physical Chemistry Department (IPC), Bangalore, India.

2020 **Oral Presentation**: "Resonant tunneling in solid-state protein junctions" – Indian Institute of Science (IISC), Solid State Structural and Chemistry Unit (SSCU), Bangalore, India.

2019 **Oral Presentation**: "Protein electronics: devices and application" – Indian Institute of Scientific Educational Research, Thiruvananthapuram (IISER-TVM), Kerala, India.

2019 **Oral Presentation**: "Protein electronics: Charge transport and devices" – Department of New Chemistry Unit, JNCASR, Bangalore, India.

2018 Poster Presentation: "Permanent contacts on protein monolayer electronic junctions" – Materials and Interfaces departmental retreat, Netanya, Israel.

2018 **Oral Presentation (Invited)**: "Controlling the mechanism of charge transport via Au-Azurin junctions" – MRS Fall Meeting, Boston, Massachusetts, USA.

2018 Poster Presentation: "Chemical modulation of contacts control energy level alignment in gold-Azurin-gold junctions" – 36$^{th}$ Annual Israel Vacuum Society (IVS) conference, Ramat Gan, Israel.

2018 **Oral Presentation**: "Resonant tunneling explains efficient electron transfer via protein junctions" – 84$^{th}$ IUVSTA conference, Weizmann Institute of Science, Israel.

2018 Poster Presentation: "Direct OFF- to ON-Resonant tunneling transition across cytochrome C in solid-state Junctions" – Conference on biomolecular electronics (BIOMOLECTRO), Madrid, Spain.

2017 Poster Presentation: "Resonant tunneling transport through protein monolayers" – 35$^{th}$ Annual Israel Vacuum Society (IVS) conference, Weizmann Institute of Science, Israel.

2017 **Oral Presentation**: "Role of coupling in charge transport through protein monolayers" – 14$^{th}$ European Conference on Molecular Electronics (ECME), Dresden, Germany.

2017 **Oral Presentation**: "Experimental evidence for resonant tunneling via protein monolayers" – Israel Vacuum Society-Material Research Society (IVS-MRS) Conference, Weizmann Institute of Science, Israel.

2017 **Oral Presentation**: "Coulomb blockade-like behavior in protein monolayers" – 9$^{th}$ International Conference on Materials and Advanced Technologies (ICMAT), Singapore.

2017 Poster Presentation: "Coherent transport through protein monolayers" – Quantum effects on the biological system (QUEBS) – 2017, Hebrew University, Jerusalem, Israel.

2016 Poster Presentation: "Comparison of electrical measurements on bacteriorhodopsin-permanent vs temporary top contacts" – 34$^{th}$ Annual Israel Vacuum Society (IVS) conference, Ben-Gurion University, Israel.

2016 Poster Presentation: "Permanent contacts on protein monolayer electronic junctions" – Weizmann Institute of Science Symposium, Rehovot, Israel.

2015 **Oral Presentation (Invited)**: "Converting photons to charge carriers and probing internal energy levels" – Bio-design Institute-Centre for Biosensors & Bioelectronics, Arizona, USA.

2015 Poster Presentation: "Light absorption and emission in molecular junctions" – National Institute for Nanotechnology (NINT), National Research Council (NRC) meeting, Canada.

2014 **Oral Presentation**: "Photoresponse of molecules in molecular tunnel junctions" – Alberta Nanotechnology Symposium, University of Alberta, Canada.

2013 Poster Presentation: "Determination of interfacial barriers in active molecular tunnel junctions using photocurrent spectroscopy" – 12th European Conference on Molecular Electronics (ECME) at Imperial College London, UK.

2011 Attended ICASS conference and CIFAR Summer workshop on interdisciplinary Nano Science, Department of Chemistry, University of Alberta, Canada.

2009 **Oral Presentation**: "Synthesis of new drug like scaffolds" – NIT-T, during an interactive section with NIT-K, India.

2009 **Oral Presentation**: "Synthesis of gold nanoparticles, its characterization and application for CO Oxidation" – Chemistry Department EPFL, Switzerland.

2009 **Oral Presentation**: "Gold nanoparticles supported carbon materials for low-temperature CO oxidation" – HORIZON-2009 student symposium, India.

## Other major academic leaderships during Ph.D. and Postdoc

- Executive Member of "Nano-nexus" committee: Played a key role as "VP events" for organizing the event and bringing University of Alberta's nanotech students and industry partners together.
- Served as "VP website" in ABCampus student group (University of Alberta): responsible for the prompt posting of information to the website and ensuring that all materials (articles, group info,

events, etc.) are formatted consistently across the website and processing workflows.

- Served as “VP Events” in Chemistry Graduate Student Society (CGSS): responsible for organizing various chemistry departmental events, University of Alberta.
- Served as VP International” in Chemistry Graduate Student Society (CGSS) the University of Alberta.
- Demonstrated leadership skills by supervising and instructing judges (15-20) on their roles and responsibilities at Edmonton Regional Science Fair as team leader (2012-2015).