

Joseph Razzell Hollis, MChem MRes PhD

j.razzellhollis@gmail.com

PERSONAL PROFILE

I am a multi-disciplinary scientist specializing in analytical Raman spectroscopy of organic molecules, whether found in biological organisms, mineral matrices or organic solar cells. As part of the *Mars 2020* mission's science team, I provide expertise in collecting and interpreting Raman spectra using quantitative methods, such as spectral deconvolution and optical modeling, and characterizing how high-energy light photo-chemically interacts with complex samples. I also advocate for greater inclusivity and diversity for under-represented groups in STEM, particularly LGBT+ people, and I am a trustee for the Pride in STEM charity in the UK.

EMPLOYMENT

2020-2021 JPL Postdoctoral Scholar
Jet Propulsion Laboratory, California, USA

My research at JPL currently focuses on developing quantitative methodologies for using deep UV Raman spectroscopy to detect and investigate potential biosignatures on Mars, in preparation for operating the *SHERLOC* instrument aboard the *Mars 2020* mission.

2018-2020 NASA Postdoctoral Fellow
Jet Propulsion Laboratory, California, USA

Recipient of a NASA Postdoctoral Program fellowship with the Planetary Science & Astrobiology group at JPL. My fellowship focused on developing quantitative methodologies for using deep UV Raman spectroscopy to detect and investigate potential biosignatures on Mars.

2007-2018 Visual Effects Artist
Self-employed, UK

Freelance work on advertisements and feature films, specializing in rotoscoping, 2D compositing and 3D modelling/animation.

EDUCATION

2012-2016 PhD in Physics
Imperial College London, UK

Thesis title: "Understanding Morphology and Photostability of Organic Solar Cells via Advanced Structural Probes"

Conducted novel research using advanced analytical techniques to probe the nanoscale morphology and photo-stability of organic solar cells based on blends of semiconducting organic molecules.

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2011-2012 MRes in Plastic Electronics - Distinction

Imperial College London, UK

Trained across multiple disciplines regarding the synthesis, fabrication and characterization of organic semiconductors and next-generation plastic electronic devices.

2007-2011 Undergraduate Masters in Chemistry – First Class (Honours)

University of Sussex, UK

Studies covered physical, organic and inorganic chemistry, including modules such as Computational Chemistry, Modern Materials, Chemical Kinetics and Heterocyclic Chemistry. My Masters research project was a theoretical investigation of atomic lithium diffusion within graphite lattices used as electrodes for lithium-ion batteries.

RESEARCH EXPERIENCE

Knowledge Base

- The use of vibrational and absorption/luminescence spectroscopy to detect and investigate the properties of chemical compounds
- Chemistry to a high level, particularly physical and theoretical chemistry
- Material science, as it pertains to organic semiconductors and plastic electronics
- Planetary science and astrobiology, focusing on the potential for past life and/or habitability of Mars

Technical Expertise

- Confocal Raman and fluorescence micro-spectroscopy, UV-Vis absorption and reflectance spectroscopy
- Probing highly localized properties at metal/organic interfaces using Surface-Enhanced Raman Spectroscopy (SERS)
- Mapping of surface nanostructures and composition using Atomic Force Microscopy (AFM) and Scanning Kelvin Probe Microscopy (SKPM)
- Sample preparation in wet chemistry labs and clean room environments
- Theoretical modelling of organic molecules using DFT simulations
- Trained in the safe use of lasers, UV light sources, cryogenic liquids and inert gases

IT & Visual Effects

- Automated data handling and spectral analysis using the Python programming language
- Creative use of artistic programs such as Adobe Illustrator to generate visually striking and effective scientific diagrams and figures for publications
- Modelling, animation and rendering of 3D objects

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Admin & Management

- Assistant lab manager for a spectroscopy lab, responsible for microscopes, nitrogen gas supply and chemical risk assessments
- Coordinated research projects across multiple departments and universities
- Prepared and submitted independent research proposals for EPSRC, NASA and Marie Skłodowska-Curie fellowships

Teaching & Collaboration

- Trained and supervised five students conducting their Masters degree research projects, all of whom have gone on to do their own PhDs
- Supervised 2 undergraduate interns conducting lab-work at NASA JPL
- Collaborated with other researchers from a range of disciplines, with most partnerships resulting in published papers

Other Skills

- Flexible and fast learner, having switched disciplines multiple times
- Scientifically literate across a range of subjects, from mineralogy to photo-chemical physics
- Effective communicator in both oral and written English, with commendations for the quality of my visual presentations
- Keen problem solver, I enjoy finding creative solutions to complex problems

PUBLICATIONS

1. J. Razzell Hollis, S. Ireland, W. Abbey, R. Bhartia, and L. W. Beegle, “**Deep-Ultraviolet Raman Spectra of Mars-Relevant Evaporite Minerals under 248.6 nm Excitation**”, submitted Feb 2020
2. V. Fox, R. Kupper, B. Ehlmann, J. Catalano, J. Razzell-Hollis, W. J. Abbey, D. Schild, R. Nickerson, and J. Peters, “**Synthesis and characterization of Fe(III)-Fe(II)-Mg-Al smectite solid solutions and implications for planetary science**”, submitted Jan 2020
3. P. E. Martin, B. Ehlmann, N. H. Thomas, R. C. Wiens, J. Razzell Hollis, L. W. Beegle, R. Bhartia, S. M. Clegg, and D. L. Bailey, “**Studies of a Lacustrine-Volcanic Mars Analog Field Site with Mars-2020-like Instruments**”, *Earth & Space Science*, accepted Jan 2020
4. J. Razzell Hollis, D. Rheingold, R. Bhartia, and L. W. Beegle (2020) “**An Optical Model for Quantitative DUV Raman Spectroscopy on Earth and Mars**”, *Appl. Spectrosc.*, in press, DOI: 10.1177/0003702819895299
5. H. Sapers, J. Razzell Hollis, R. Bhartia, L. W. Beegle, V. J. Orphan, and J. P. Amend, “**The cell and the sum of its parts: patterns of complexity in biosignatures as revealed by deep UV Raman spectroscopy**”, *Frontiers in Microbiology*, 2019, 10, 679. DOI: 10.1063/1.4803912
6. S. Wood, J. Razzell Hollis, and J.-S. Kim; “**Raman spectroscopy as an advanced structural nanoprobe for conjugated molecular semiconductors**” *J Phys. D: Appl. Phys.*, 2017, 50 (7), 73001. DOI: 10.1021/acs.jpcc.6b02898

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7. J. Razzell Hollis, F. D. Fleischli, A. A. Jahnke, N. Stingelin, D. S. Seferos, and J.-S. Kim, “**Effects of Side-Chain Length and Shape on Polytellurophene Molecular Order and Blend Morphology**” *J. Phys. Chem. C*, 2016, 121 (4), 2088-2098. DOI: 10.1021/acs.jpcc.6b11675
 8. J. Razzell-Hollis, Q. Thiburce, W. C. Tsoi, and J.-S. Kim, “**Interfacial Chemical Composition and Molecular Order in Organic Photovoltaic Blend Thin Films Probed by Surface- Enhanced Raman Spectroscopy**” *ACS Appl. Mater. Interfaces*, 2016, 8 (45), 31469–31481. DOI: 10.1021/acsami.6b12124
 9. J. Razzell-Hollis, S. Limbu, and J.-S. Kim, “**Spectroscopic Investigations of Three-Phase Morphology Evolution in Polymer: Fullerene Solar Cell Blends**” *J. Phys. Chem. C*, 2016, 120, 10806–10814. DOI: 10.1021/acs.jpcc.6b02898
 10. C. Hellmann, N. D. Treat, A. D. Scaccabarozzi, J. Razzell Hollis, F. D. Fleischli, J. H. Bannock, J. de Mello, J. J. Michels, J.-S. Kim, and N. Stingelin, “**Solution processing of polymer semiconductor: Insulator blends-Tailored optical properties through liquid- liquid phase separation control**” *J. Polym. Sci. Part B Polym. Phys.*, 2015, 53, 304–310. DOI: 10.1002/polb.23656
 11. J. Razzell-Hollis, J. Wade, W. C. Tsoi, Y. Soon, J. Durrant, and J.-S. Kim, “**Photochemical stability of high efficiency PTB7:PC₇₀BM solar cell blends**” *J. Mater. Chem. A*, 2014, 2, 20189–20195. DOI: 10.1039/c4ta05641h
 12. W. C. Tsoi, W. Zhang, J. Razzell Hollis, M. Suh, M. Heeney, I. McCulloch, and J.-S. Kim, “**In- situ monitoring of molecular vibrations of two organic semiconductors in photovoltaic blends and their impact on thin film morphology**” *Appl. Phys. Lett.*, 2013, 102, 173302. DOI: 10.1039/c3tc31245c
 13. J. Razzell-Hollis, W. C. Tsoi, and J.-S. Kim, “**Directly probing the molecular order of conjugated polymer in OPV blends induced by different film thicknesses, substrates and additives**” *J. Mater. Chem. C*, 2013, 1, 6235–6243. DOI: 10.1063/1.4803912

CONFERENCES

2020 Lunar and Planetary Sciences Conference – USRA, Houston, USA

Oral Presentation: “In-Situ Alteration of Organic Biosignatures in Perchlorate-Spiked Martian Regolith Analog”

2019 AGU Fall Meeting – San Francisco, USA

Poster Presentation: “In-Situ Alteration of Organic Biosignatures in Perchlorate-Spiked Martian Regolith Analog”

Poster Presentation: “Raising Visibility: Materials for LGBT+ Diversity and Inclusivity in STEM”

2019 Lunar and Planetary Sciences Conference – USRA, Houston, USA

Poster Presentation: “Quantitative DUV Raman Analysis for Detecting Organic Biosignatures”

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2019 LGBT STEMinar — Institute of Physics, UK

Poster Presentation: “Quantitative DUV Raman Analysis for Detecting Organic Biosignatures”

2018 AGU Fall Meeting — Washington D.C., USA

Poster Presentation: “Quantitative DUV Raman Analysis for Detecting Organic Biosignatures”

2016 Centre for Plastic Electronics Annual Lecture — London, UK

Oral Presentation: “Probing Interfacial Properties with SERS”

2016 LGBT STEMinar — Sheffield, UK

Oral Presentation: “Organic Photovoltaics: Plastic Power”

2015 Centre for Plastic Electronics Annual Lecture — London, UK

2014 International Conference on Organic Electronics (ICOE) — Modena, Italy

Poster Presentation: “Photo-Stability of PTB7:PC70BM Organic Solar Cells”

2013 European Conference on Molecular Electronics (ECME) — London, UK

2012 European Materials Research Society (EMRS) — Strasbourg, France

Poster Presentation: “Probing the Molecular Order of OPV Blends”

AWARDS

2015 CPE Annual Lecture - Best Poster Prize

2011 MChem Project - Murrell Prize for Theoretical Chemistry

PROFESSIONAL MEMBERSHIP

Associate Member of the Institute of Physics (UK)

Member of the American Geophysical Union (USA)

DIVERSITY & INCLUSION

- Trustee of the *Pride in STEM* charity in the UK, and co-organizer of the 2017 *Out Thinkers* event series, which celebrates the lives and work of LGBT+ scientists and engineers
- Runs the @LGBT_Physics twitter account
- Creator of several materials promoting better policies for LGBT+ diversity in the lab, available for free use here:
<https://drive.google.com/drive/folders/0B6yUyaU0iOLQckdVX3V0YjAwYVU?usp=sharing>
- Organized and run an LGBT+ Physics outreach stall at Brighton Pride in 2017, with support from the Institute of Physics
- Writer of several published articles on issues surrounding LGBT+ experiences in STEM:

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- Guest article about coming out in the workplace for the Royal Society's blog *in Verba*, and was a speaker at their **Out In STEM** event in 2016
<https://blogs.royalsociety.org/in-verba/2016/02/09/out-and-proud-in-stem/>
- Two-part guest article for *Digital Science*, called "**The Beginners Guide to Being an LGBT+ Ally**"
<https://www.digital-science.com/blog/guest/beginners-guide-lgbt-ally-part-1/>
- Guest article for *Digital Science*, called "**Diversity in Science, Post-Brexit**"
<https://www.digital-science.com/blog/guest/diversity-science-post-brexit/>