

Exponent®
Engineering & Scientific Consulting


# Ryan Spray, Ph.D.

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## Professional Profile

Dr. Spray supports clients by solving technical problems involving chemistry, electrochemistry, materials science, and battery science. His core competency is inorganic chemistry, and he specializes in electrochemistry and surface chemistry which enables him to provide chemistry-based solutions to many industries such as consumer electronics, medical devices, transportation, and energy storage

Dr. Spray has conducted performance and failure analyses on many products and devices including primary and rechargeable batteries (i.e., lithium-ion, lead-acid, NiMH, LiSOCl2, thin film), consumer electronic devices, coatings, medical devices and various electrical components. In the field of batteries and energy storage, he is skilled at performing performance and accelerated life analysis, cell design and materials evaluation, technical due diligence, technical IP analysis and litigation support. He has extensive expertise in applying non-destructive analysis techniques, notably high-resolution computed tomography X-ray (CT) scanning, to solve various technical problems related to manufacturing processes, corrosion, mechanical wear and intricate defect analysis.

Dr. Spray has extensive experience in materials characterization techniques for structure and composition such as surface profilometry, electron microscopy (TEM/ED and SEM/EDS), X-ray [diffraction, spectroscopy, computed tomography (CT)], N2 Adsorption (BET), Thermogravimetric Analysis (TGA), Accelerating Rate Calorimetry (ARC), and various spectroscopy techniques (UV-vis, IR, Auger, and Raman). He is also skilled in a variety of electrochemical [voltammetry, impedance, Quartz-Crystal Microgravimetry (QCM)] and photoelectrochemical methods [photocurrent, efficiency (IPCE)].

Prior to joining Exponent, Dr. Spray worked as a research assistant at Purdue University, where he studied thin film and porous materials with an emphasis on applications to lithium-ion battery electrodes and solar energy conversion. He developed new electrochemical deposition techniques for nanostructured and mesoporous metal oxide films and studied the effects of composition tuning and catalysts toward their applications to photoelectrochemical cells.

## Academic Credentials & Professional Honors

Ph.D., Chemistry, Purdue University, 2009

B.S., Chemistry, Wittenberg University, 2004

## Prior Experience

Research Assistant, Purdue University, 2004-2009

Intern Project Manager, Owens Corning Science & Technology Center, 2004

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Research Assistant, Wittenberg University 2003-2004

## Professional Affiliations

American Chemical Society

The Electrochemical Society

## Publications

Spray R.
Colella F, Mendoza S, Barry M, Kossolapov A, Spray R, and Myers T. Energy Release Quantification for Li-Ion Battery Failures. In Compliance Magazine, Jan 11, 2022.

(Featured in) “Inside Job” Consumer Electronics Test and Development Aug 7, 2023.

(Featured in) “Powering Ahead” Consumer Electronics Test and Development May 11, 2022.

"The Influence of Cycling, Temperature, and Electrode Gapping on the Safety of Prismatic Lithium-Ion Batteries" Zhuhua Cai et al 2020 J. Electrochem. Soc. 167 160515 (https://iopscience.iop.org/article/10.1149/1945-7111/abcabc/meta)

Spray R, Barry M. Understanding downstream risk from lithium-ion battery thermal runaway and designing for safety. Battcon Conference Proceedings. Nashville, TN, April 22-25, 2018.

Colella F, Marr K, Ponchaut NF, Somandepalli V, Spray R. Analysis of combustion hazards due to catastrophic failures in lithium-ion battery packs. Proceedings, 7th International Seminar on Fire and Explosion Hazards, Providence, RI, May 5-10, 2013.

Spray RL, McDonald KJ, Choi K-S. Enhancing photoresponse of nanoparticulate α-Fe2O3 electrodes by surface composition tuning. The Journal of Physical Chemistry C 2011; 115(8):3497-3506.

Jung Y, Spray RL, Kim JH, Kim JM, Choi KS. Selective polymerization of polypyrrole in silica mesopores using an in situ generated oxidizing agent on a silica surface. Chemical Communications 2010; 46; 6566-6568.

Spray RL, Choi KS. Photoactivity of transparent nanocrystalline Fe2O3 electrodes prepared via anodic electrodeposition. Chemistry of Materials 2009; 21(15):3701-3709.

Spray RL, Choi KS. Electrochemical synthesis of SnO2 films containing three-dimensionally organized uniform mesopores via interfacial surfactant templating. Chemical Communications 2007; 35:3655-3657.

Ellison MD, Crotty MJ, Koh D, Spray RL, Tate KE. Adsorption of NH3 and NO2 on single-walled carbon nanotubes. The Journal of Physical Chemistry B 2004; 108(23):7938-7943.

**Presentations**

**Barry M, Vickery J, Spray R. Variation in thermal runaway characteristics in lithium-ion cells from different manufacturers. IEEE Symposium on Product Compliance Engineering. Boston, MA, November 12-13, 2018.**

**Bogart T, Licht R, Beers K, Godshaw J, Rucker R, Forman J, White K. Understanding Degradation of**

Lithium-Ion Battery Performance. Advanced Automotive Battery Conference (AABC), San Diego, CA, 2018.

Spray R, Barry M, Forman J, White K, Horn Q, Typical Failure Modes and Design Considerations for xEV Lithium-Ion Batteries. Plugvolt Battery Seminar 2018, Plymouth, MI, July 18, 2018.

Spray R, Barry M, Brown C, Marr K. Understanding downstream risks from battery thermal runaway and designing for safety. IEEE Symposium on Product Compliance Engineering. Boston, MA, November 6-7, 2017.

Spray R. An Inside Look at Lithium-ion Batteries. Greater Boston Chapter Meeting of American Society of Safety Engineers (ASSE). Natick, MA, March 22, 2017.

Spray R, Swart J. Float Charging and Its Effects on Lithium-Ion Cells - What Can We Learn? International Meeting on Lithium Batteries (IMLB), Chicago, IL, June 2016.

Spray R, Marr K, White K, Horn Q. Understanding and Mitigating the Downstream Risk from Thermal Run-Away. NASA Aerospace Battery Workshop. Huntsville, AL, 2015 and 2017.

Somandepalli, V, Spray, R. Is My Flight Battery Safe? - Safety Considerations for Small and Medium Electric UAS Batteries. AUVSI Unmanned Systems 2015, Atlanta, GA, May 4, 2015.

Spray RL, White K. An Inside Look at Lithium-Ion Cell Materials, Design, Assembly, Function and Safety. Invited Oral Presentation, Texas Instruments Deep Dive, Richardson, TX, October 2013, 2014 and 2017.

Spray RL, Clevenger J, Mann R, White K. Lessons from Manufacturing of Regulated Electronic Products. Oral Presentation, New England iMAPS Tech Symposium, Boxborough, MA, May 7, 2013.

Spray RL, Forman J, Horn Q, Shah K, White K. Towards an accessible methodology for measurement of cell performance with aging. Oral Presentation, 30th Annual International Battery Conference, Ft. Lauderdale, FL, March 2013.

Horn Q, White K, Spray R. Mapping thermal stability of lithium-ion cells. Invited presentation at the Dow-Kokam Advanced Battery Technology Exchange, Lee's Summit, MO, October 20, 2011.

White K, Horn Q, Singh S, Spray R and Budiansky N. Thermal Stability of Lithium-ion Cells as Functions of Chemistry, Design and Energy. Lithium Mobile Power, Boston, MA, November 4, 2010.

White K, Horn Q, Singh S, Spray R. Thermal stability of lithium-ion cells as functions of chemistry, design and energy. Invited Presentation, International Battery Association Conference, Kona, HI, January 2010.

Spray RL, McDonald KJ, Choi KS. Enhanced photoelectrochemical properties of electrodeposited iron oxide ($\alpha$-$Fe_2O_3$) films using surface treatments. Poster Presentation, Materials Research Society 2010 Fall Meeting, Boston, MA, November 2010.

Jung Y, Spray RL, Choi KS. Selective polymerization of polypyrrole in silica mesopores using an in-situ generated oxidizing agent on a silica surface. Oral Presentation, Materials Research Society 2010 Fall Meeting, Boston, MA, November 2010.

Spray RL, Choi KS. Photoelectrochemical properties of nanocrystalline $\alpha$-$Fe_2O_3$ electrodes prepared via new electrodeposition route. Oral Presentation, Materials Research Society 2009 Spring Meeting, San Francisco, CA, April 2009.

Spray RL, Choi KS. Characterization of transparent nanocrystalline $\alpha$-$Fe_2O_3$ electrodes prepared via new anodic deposition conditions. Poster Presentation, Purdue Indiana Notre Dame Universities (PINDU) Inorganic Symposium, Bloomington, IN, November 2008.

Spray RL, Choi KS. Electrochemical/thermal synthesis of highly transparent, mesostructured hematite electrodes for photoelectrochemical applications. Poster Presentation, Gordon Research Conference on Electrodeposition, New London, NH, July 2008.

Spray RL, Choi KS. Electrodeposition of nanostructured tin and tin oxide using amphiphilic surfactants as structure directing agents. Poster Presentation, Purdue Indiana Notre Dame Universities (PINDU) Inorganic Symposium, Bloomington, IN, December 2005.

Spray RL, Tate KE, Ellison MD. Infrared studies of NH3 and NO2 interactions with single-walled carbon nanotubes. Poster Presentation, ACS Regional Conference, Pittsburgh, PA, October 2003.

Contributor

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https://incompliancemag.com/article/energy-release-quantification-for-li%e2%80%91ion-battery-failures/