Dr. Nicholas M. Randell, PhD

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Summary

Experienced PhD chemist/materials scientist with extensive knowledge of organic electronics, polymer synthesis, and spectroelectrochemistry, seeking opportunities to apply myself in the field of sustainable chemistry/energy research.

Key Skills

- **Chemical synthesis:** Ten years of air-free organic/inorganic synthesis including: Pd catalyzed polymerizations, transition metal complex synthesis and molecular synthesis specializing in π-conjugated materials. Macromolecular synthesis experience including both supramolecular coordination chemistry and organic polymer synthesis. Highly knowledgeable in purification techniques ranging from chromatography to soxhlet extraction and crystallizations.
- **Electrochemical Analysis:** Highly skilled in electrochemical analysis such as voltammetry, amperometry, and electrolysis. Knowledgeable in the use of electrochemical methods to determine diffusion rates of analytes and electrode surface area such as capacitance measurements. Experienced with *ad-hoc* experimental setups combining multiple characterization techniques such as spectroscopically coupled electrochemistry to characterize transient species and chromatography-coupled electrochemistry to monitor product formation.
- **Characterization**: Experienced in structural characterization techniques such as NMR, mass spectrometry, molecular weight determination, atomic force microscopy, scanning electron microscopy, and x-ray diffraction techniques. Highly skilled in electronic characterization techniques such as UV/vis spectroscopy and fluorimetry and infrared spectroscopy.
- **Electronic device fabrication/testing:** Expert in thin film device fabrication techniques including spin-coating and high vacuum thermal evaporation. Highly experienced in organic solar cell testing techniques included the use of source-measure units to generate current-voltage performance characteristics and the collection of external quantum efficiency measurements performed both in air and under inert atmosphere.
- **Management:** Experienced with supervision and mentorship of junior laboratory staff included junior graduate students and undergraduate researchers. Proficient in organizing collaborative research relationships across multiple teams with highly varied backgrounds both within a research institution and externally.
- **Communication:** First-language English, conversationally fluent in French. Highly experienced in the writing and editing of manuscripts for scientific publication including 9 first author publications. Skilled at oral presentation of research results having presented research at many national/international scientific conferences.

Research Experience

Post-Doctoral Researcher – Department of Chemistry, University of Calgary, August 2019 - Present

- Funding: NSERC Post-doctoral Fellowship, Supervisor: Simon Trudel
- Fabricated thin-film solar cells with novel amorphous CuO_x hole-transport layers via spin coating, slot-die coating, and thermal evaporation.
- Studied the structural evolution of amorphous metal-oxides using synchrotron-based x-ray absorption techniques.
- Conceived a polymer:metal nanocomposite fabrication technique involving co-deposition of precursors followed by UV-light treatment in inert atmosphere.
- Explored the photoelectrocatalytic performance of polymer:metal nanocomposites for CO_2 reduction using advanced electrochemistry techniques including voltammetry, chopped-light chronoamperometry, and capacitance measurements.

Post-Doctoral Researcher – SolHyCat Group, LCBM, CEA Grenoble, February 2018 - July 2019

- Funding: CEA Département de Recherche Fondamentale, Supervisors: Murielle Chavarot-Kerlidou, Vincent Artero
- Synthesized Ru(II) complexes with π-conjugated electron storage reservoirs for multi-electron solar fuel forming reactions. This involved microwave synthesis, automated flash chromatography, and air sensitive synthetic techniques.
- Tested optoelectronic properties of the resulting dye/electron-reservoir systems using UV/vis spectroscopy coupled with electrochemical techniques performed in an inert atmosphere glovebox in darkroom conditions.
- Coordinated a collaborative research program across multiple research teams at the CEA and across Europe.
- Produced and presented annual project updates for funding agency as well as published a peer-reviewed journal article.

PhD Researcher – Department of Chemistry, University of Saskatchewan, September 2012 - November 2017

- Funding: NSERC CGS-M/CGS-D3, Supervisor: Timothy L. Kelly
- Synthesis of isoindigo-based molecular and polymer organic semiconductors for use in thin film organic solar cells using classical organic synthetic techniques as well as air-free cross coupling reactions and Pd catalyzed polymerizations.
- Characterization of structural and optoelectronic properties of resulting materials including NMR spectroscopy, molecular weight determination, UV/vis spectroscopy/fluorimetry, and electrochemical characterization.
- Fabrication/testing optimization of prototype organic solar cells. Fabrication techniques included: spin-casting, thermal evaporation. Device testing/characterization included atomic force microscopy, synchrotron-based x-ray scattering techniques, and current-voltage/external quantum efficiency measurements performed in an inert atmosphere glovebox.
- Wrote and published five first-author peer-reviewed journal articles, as well as equipment and safety-related standard operating procedures.

Undergraduate Researcher – Dept. of Chemistry, Memorial University of Newfoundland, Sept 2011- Aug 2012

- Funding: NSERC USRA, Supervisors: Laurence K. Thompson, Louise N. Dawe
- Synthesized supramolecular transition metal complexes in a 2x2 square geometry using a variety of lanthanide metals.
- Performed single-crystal x-ray diffraction and structure resolution using the OLEX2 software suite.
- Performed SQUID magnetometry measurements and magnetometry data analysis.

Selected Peer Reviewed Journal Articles

1. **N.M. Randell**, R. Miclette-Lamarche, F. Tintori, R. Chernikov, G. Welch, S. Trudel; Photodeposited Polyamorphous CuO_x Hole-Transport layers in organic photovoltaics, *ACS Appl. Energy Mater.* **2021,** 4, 12900-12908**,** DOI: 10.1021/acsaem.1c02577
2. M.A.W. Schoen, **N.M. Randell**, O. Calderon, S. Jimenez Villegas, Z. Thomson, R. Chernikov, S. Trudel; Structural Evolution in Photodeposited Nickel (oxy)hydroxide Oxygen Evolution Electrocatalysts, *ACS Appl. Energy Mater*. **2020**, 3, 12, 12407–12416 DOI:10.1021/acsaem.0c02383
3. **N.M. Randell**, J. Rendon, M. Demeunynck, P.-A. Bayle, S. Gambarelli, V. Artero, J.-M. Mouesca, M. Chavarot-Kerlidou; Tuning the Electron Storage Potential of a Charge-Photoaccumulating Ru(II) Complex by a DFT-Guided Approach, *Chem. Eur. J.*, **2019**, 25, 13911-13920 DOI: 10.1002/chem.201902312
4. **N.M. Randell**, T.L. Kelly; Recent Advances in Isoindigo-Inspired Organic Semiconductors, *Chem. Rec.,* **2018**, 19, 973-988, DOI: 10.1002/tcr.201800135
5. **N.M. Randell,** C.L. Radford, J. Yang, J. Quinn, D. Hou, Y. Li, T.L. Kelly; Effect of Acceptor Unit Length and Planarity on the Optoelectronic Properties of Isoindigo-Thiophene Donor-Acceptor Polymers, *Chem. Mater.,* **2018,** 30**,** 4864-4873 DOI: 10.1021/acs.chemmater.8b02535
6. **N.M. Randell**, K.F. Fransishyn, T.L. Kelly; Lewis Acid-Base Chemistry of 7-Azaisoindigo-Based Organic Semiconductors, *ACS Appl. Mater. Interfaces* **2017**, 9, 24788-24796, DOI: 10.1021/acsami.7b06335
7. **N.M. Randell**, P.C. Boutin, T.L. Kelly; Bisisoindigo: Using a Ring-Fusion Approach to Extend the Conjugation Length of Isoindigo, *J. Mater. Chem. A*, **2016**, 4, 6940-6945, DOI: 10.1039/C5TA07511D
8. **N.M. Randell**, A.F. Douglas, T.L. Kelly; 7-Azaisoindigo as a New Electron Deficient Component of Small Molecule Chromophores for Organic Solar Cells, *J. Mater. Chem. A*, **2014**, 2, 1085-1092, DOI: 10.1039/c3ta14263a
9. **N.M. Randell,** M.U. Anwar, M.W. Drover, L.N. Dawe, L.K. Thompson; Self-Assembled $Ln(III)_4$ (Ln = Eu, Gd, Dy, Ho, Yb) [2 × 2] Square Grids: a New Class of Lanthanide Cluster, *Inorg. Chem.,* **2013,** 52, 6731-6742, DOI: 10.1021/ic4008813

Education

Doctor of Philosophy (Chemistry)

University of Saskatchewan, Saskatoon, SK 2012-2017

- Supervisor: Dr. T.L. Kelly
- Thesis Title: Tuning the Properties of Isoindigo-Based Organic Semiconductors Through Structural Engineering

Bachelor of Science – Honours (Chemistry)

Memorial University of Newfoundland, St. John's, NL 2008-2012

- Major: Chemistry, Minor: Mathematics
- Honours Supervisors: Dr. L.K. Thompson, Dr L.N. Dawe
    - Thesis Title: Self-assembled Poly-Nuclear Coordination Complexes; A Structural and Magnetic Study