Zernike Colloquium

May 12th, 2022
16:00h
NB 5111.0080

Developing and applying new tools to understand how materials for Li and "beyond-Li" battery technologies function

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Rechargeable batteries have been an integral part of the portable electronics revolution and are now playing an increasingly important role in transport and grid applications, but the introduction of these devices comes with different sets of challenges. New technologies are being investigated, such as those involving reactions between Li and oxygen/sulfur, using sodium and magnesium ions instead of lithium, or involving the flow of materials in an out of the electrochemical cell (in redox flow batteries). Importantly, fundamental science is key to producing non-incremental advances and to develop new strategies for energy storage and conversion.

This talk will start by briefly describing existing battery technologies, what some of the current and more long-term challenges are, and touch on strategies to address some of the issues. I will then focus on our own work to develop NMR, MRI and optical methods that allow devices to be probed while they are operating (i.e., operando), at the local, particle and cell level. This allows transformations of the various cell components to be followed under realistic conditions without having to disassemble and take apart the cell. We can detect side reactions involving the electrolyte and the electrode materials, sorption processes at the electrolyte-electrode interface, and processes that occur during extremely fast charging and discharging. Many of the battery electrode materials are paramagnetic and their study has involved the development of new experimental (NMR) and theoretical approaches to acquire and interpret spectra. Recent studies to correlate lithium hyperfine shifts with local structure and to probe dynamics will be described, focussing on studies aimed to understand degradation in NMC-811 ($Li[Ni_{0.8}Co_{0.1}Mn_{0.1}]O_2$) – graphite full cells. Finally, new results on phase transitions in particles, redox flow, solid state electrolytes, and extremely high-rate batteries will be outlined.

Coffee from 15:30h
Drinks & Snacks after

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