Title: Solid Electrolytes and Next Generation Rechargeable Lithium Metal Batteries

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Abstract: Low energy density, finite availability and high cost of cathodes/anodes used in the current lithium-ion batteries (LIBs) are inadequate to fully electrify modern transportation, support smart grids, conventional power plants and modern air and spacecraft. Lithium-oxygen (Li-O_2), lithium-sulfur (Li-S), and lithium-Li-ion (Li-LIB) are most prominent future energy storage technologies [1]. Success of Li-LIB depends on development of high energy/voltage cathode, whereas, Li-S battery is in advance stage of commercialization, but cycle-life and safety of Li-S battery are questionable. Research on Li-O_2 is still in infancy but if successfully developed can store more energy compared to Li-LIB and Li-S battery.

UD's solid-state Li-O_2 battery cells [2] comprised of Li metal anode, solid ceramic electrolyte (SCE) and ceramic-carbon O_2-cathode. Unlike liquid electrolyte used in other Li-O_2 cell design [3], use of SCE can enable: stability with electrodes, dendrite prevention, protection of Li from environmental impurities (H_2O, CO_2, etc.) and high temperature battery operation. SCE plays multiple roles when used as electrolyte in cathode, for example, ceramic store and transport O_2 and also catalyze O_2 reduction in cathode and thus allow design of a closed Li-O_2 cell. Practical reality of Li-O_2 battery depends on: (1) low weight O_2-cathode that allows seamless transport and meeting (**triple point**) of reactants (O_2, Li^+ ion, electron), catalyze O_2 reduction at high rate and accommodate large amount of discharged product, (2) conducting electrolyte impermeable to gases and moisture, (3) high rate anode capable of sustaining high volume changes during charge-discharge process, (4) researching factors that can enable long-term functioning of battery, and (5) understanding reaction mechanism.

Presentation will include progress on SCE research being pursued at University of Dayton for the development of both Li-S and Li-O_2 batteries [4].

References:

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2. Kumar et. al. *J., Electrochem. Soc*., 157, 2010, A50.
3. Girishkumar et. al., *J. Phys. Chem.*, Lett. 1, 2010, 2193.
4. Kumar et. al., *J. Power Sources* 301 (2016) 194.