SEMTE seminar

Electrochemistry of oxygen with lithium and protons: Implications for lithium-air batteries and fuel cells

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abstract

Oxygen electrochemistry has a key role to play in modern electrochemical systems such as fuel cells and metal-air batteries. I will discuss my work in developing a theoretical understanding in the two broad topics of electrochemistry of oxygen with lithium and protons.
Li-air batteries have much higher gravimetric energy storage density compared to all other battery chemistries, and this has led to a strong interest in seeing if such batteries could be developed for powering EVs, enabling driving ranges comparable to gasoline powered automobiles. However, many fundamental challenges exist in these batteries that need to be solved before these batteries can become practical. I will address three issues relating to the practicality of non-aqueous Li-air batteries - (1) Thermodynamic efficiency, (2) Limitations during deep discharge and (3) Rechargeability of non-aqueous Li-air batteries.

In the second half of my talk, I will present a unifying analysis of the reduction of oxygen with protons and demonstrate that there is an universal activity volcano for oxygen reduction on metals, independent of facets. Building on this, I will also demonstrate that this simple thermodynamic treatment can explain trends in selectivity between 2e- and 4e- reduction of oxygen. We find quite a remarkable agreement between the prediction of this analysis and nearly 30 years of experimental results in oxygen reduction.

biosketch

Venkat Viswanathan, pursuing his PhD at Stanford University under the guidance of Jens Norskov working on lithium-air batteries and fuel cells. He was the recipient of the United Technologies Renewable Energy Fellowship at Stanford University. He got his undergraduate degree at Indian Institute of Technolgy, Madras in 2008. He is the recipient of Electrochemical Society (ECS) Daniel Cubbiciotti award in 2010 and ECS Herbert H Uhlig Summer Fellowship in 2009. He was a gold medalist at the Chemistry Olympiad in 2003.

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