Elucidating Energy Storage in Soft Nanostructures through Versatile Electrochemistry

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My group is interested in exploring the impact of structural and reactive heterogeneity in soft materials for energy storage. New materials and an expanded electroanalytical toolbox is allowing us to discover synergies at the nano and mesoscale for emerging battery technologies. In my talk, I will discuss two systems where nano-scale heterogeneity has an impact on macro-scale performance: novel redox active polymers (RAPs) for size-selective flow batteries, and ultra-thin graphene electrodes. Highly soluble RAPs are new players in redox flow technologies, and as part of our collaboration with the Joint Center for Research Energy Storage (JCESR), we are exploring the opportunities that polymeric design offers for tuning their electrochemical performance. Likewise, graphene is an emerging material that offers new opportunities in contrast to bulk carbon due to its unique thickness-dependent electron and ion transfer behavior. In both cases, short range interactions between their components determine charge transfer and transport mechanisms. It is essential to develop new tools that afford the required versatility to study these processes in situ. For this purpose, my group develops nano-electrochemical methods based on scanning electrochemical microscopy (SECM) that uniquely probe electronic and ionic processes in real time. Using these and other tools, we are starting to understand fundamental balances between electronic and ionic reactivity that we hope will have an impact on a various other applications for energy conversion and storage.

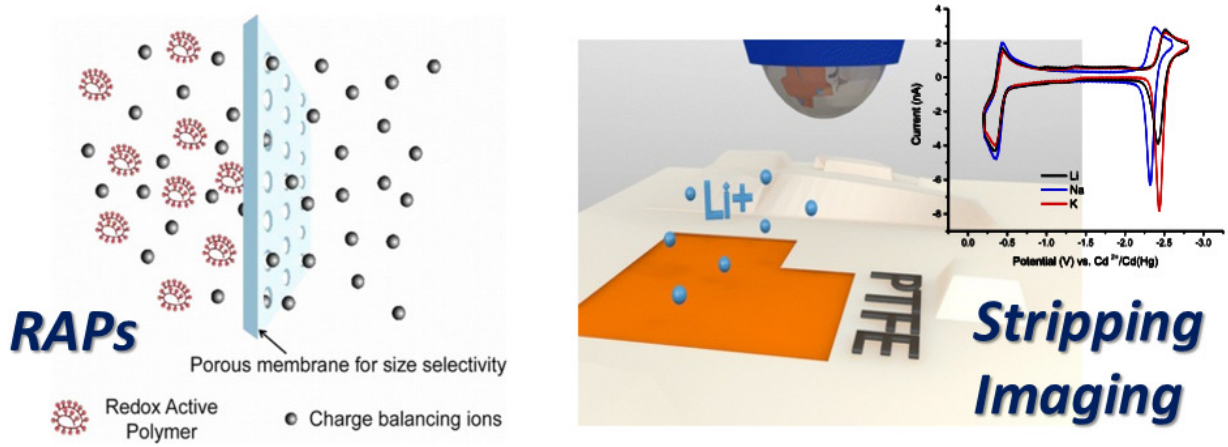

Figure 1. New materials and new techniques for energy storage: ***Left-*** Redox active polymers for size-selective flow batteries. ***Right***- Ion stripping imaging SECM for local in situ battery studies.

References:

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