Seminar in Energy

"Prussian Blue Analogues: Battery Materials For Grid-Scale Energy Storage Applications"
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Abstract
New types of energy storage are needed in conjunction with the deployment of solar, wind, and other volatile renewable energy sources and their integration with the electrical grid. No existing energy storage technology can provide the power, cycle life, and energy efficiency needed to respond to the costly short-term transients that arise from renewables and other aspects of grid operation. We recently introduced a new family of insertion electrodes based on the open framework crystal structure of Prussian Blue. This structure is composed of a face-centered cubic framework of transition metal cations where each cation is octahedrally coordinated to hexacyanometallate groups. Large interstitial "A Sites" within the structure can accommodate zeolitic water and alkali ions allowing rapid insertion and removal of Na+, K+, and other ions from aqueous solutions with little lattice strain. The result is an extremely stable electrode: over 40,000 deep discharge cycles were demonstrated in the case of copper hexacyanoferrate.
We were able to demonstrate a new type of safe, fast, inexpensive, long-cycle life aqueous electrolyte battery which relies on the insertion of sodium ions into a copper hexacyanoferrate cathode and a manganese hexacyanomanganate anode, each of which have the same open framework crystal structure. The electrodes in this battery are synthesized in bulk quantities by a room temperature chemical synthesis from earth-abundant precursors and when operated in an appropriate aqueous electrolyte, show extremely long cycle life, fast kinetics, and high efficiency, resulting in a full battery cell that can meet the demands of large scale energy storage.

Biography
Dr. Mauro Pasta is a postdoctoral fellow in the Materials Science and Engineering department at Stanford University, working in Prof. Yi Cui's research group. He received his PhD in Industrial Chemistry from the University of Milan in 2010. His thesis on glucose electro-oxidation was awarded the "De Nora prize" as a best PhD thesis in electrochemistry by the Italian Chemical Society. Before joining Stanford he was a postdoctoral researcher at the Center for Electrochemical Sciences of Ruhr University-Bochum. His work on batteries for efficient seawater desalination and lithium recovery from brines was awarded the International Society of Electrochemistry Travel Award for Young Electrochemists. His research focuses on electrochemistry and materials science applied to energy storage and conversion devices. In particular he is working on batteries for stationary storage applications, energy extraction from salinity differences and carbon dioxide sequestration. Personally, Mauro is a beach volleyball player, a cyclist and an avid motorbike hobbyist.