Materials Chemistry Seminar

Thursday, Sept. 22, 2011
12:15 p.m., Room 1315

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"Designing Materials at the Nanoscale for Advanced Energy Applications"

Abstract: How to significantly advance energy conversion and storage technologies, such as solar cells, solar fuel production from water splitting, and batteries, represents a key challenge faced by the scientific community. At the heart of the problem is our inability to tailor certain aspects of materials' intrinsic properties without adversely altering others. As a result, researchers are currently working within serious constraints. Recent advances in materials research, particularly those focusing on morphology innovations at the nanoscale, may offer solutions to this problem at a fundamental level. Here, we present our recent efforts and some positive results toward this direction. We proposed and tested the idea of forming heteronanostructures, various parts of which can be purpose-designed independently. When combined together, these different parts contribute to the overall functionality in a complementary fashion, yielding materials with properties that have not been observed on simple structures. We will introduce the research within the context of a nanonet-based design, which is enabled by a unique two-dimensional crystalline material we discovered. We show that the nanonet solves the low conductivity problem many metal oxide semiconductors and battery electrode materials have. The resulting nanostructures exhibit better performance in solar water splitting and battery applications than their non-heteronanostructure counterparts do. A new door to electrode design for improved energy applications may be opened up by this approach.