

MRSEC SEMINAR SERIES

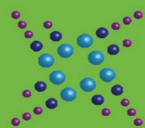
Solid-Phase Crystallization for the Preparation of Tunable Energy Conversion Nanocatalysts

Solid-phase crystallization, or exsolution, is a thermodynamically driven process where metal nanoparticles are grown by phase-segregation from within mixed-metal oxides. Nanoparticles grown in this manner have shown improved thermal and catalytic stability owing to their enhanced interaction between the particle and its support. Major drawbacks to this technique are the lack of heterogeneous structural diversity afforded and the comparatively low metal dispersion relative to other catalyst preparation techniques. Optimization of catalytic properties such as the long-term stability has been held back by a lack of understanding of the factors impacting the crystallization pathway, and its influence on the structure of the resulting catalyst. Here we show the first evidence of the importance of extended structural defects in the LNO precursor material (2D stacking faults and 3D inclusions) for determining the exsolution pathway and therefore the properties of the final catalyst. Control of extended defects is shown to be a key microstructure component for improving catalyst lifetimes. Furthermore, by leveraging differences in reducibility and composition of sites in the parent particle, core-shell structures with a tunable thickness can be exsolved.

Dr. Brian Rosen is an Assistant Professor in the Department of Materials Science and Engineering at Tel Aviv University's Iby and Aladar Fleischman Faculty of Engineering. Dr. Rosen is the founder of the department's Energy Materials Laboratory which specializes in artificial photosynthesis and synthetic fuel production, as well as catalyst design for solid-oxide and room-temperature fuel cells. Dr. Rosen develops novel synthesis techniques to design inexpensive catalysts on the nanoscale, and investigates structure-function relationships of catalytic materials under operational conditions. Dr. Rosen received his Bachelors of Chemical Engineering from the University of Delaware. His doctoral work was at the University of Illinois at Urbana-Champaign under the advisement of Prof. Richard Masel and Prof. Paul Kenis where he focused on low overpotential CO₂ conversion to CO utilizing ionic liquid electrolytes. This work was published in Science, Advanced Materials and Nature Communications. Dr. Rosen has co-authored over 15 patents describing the use of novel co-catalyst systems, utilizing both an adsorbed ionic liquid layers and unique synthetic methodologies to tailor the catalyst surface. Dr. Rosen co-founded a start-up company Dioxide Materials (Boca Raton, FL, USA) whose goal is the development of CO₂ electrolyzers that utilize these new chemistries. Dr. Rosen was named as U.S. Department of Energy Office of Science Graduate Fellow and a US-Israeli Fulbright Scholar.



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