Nanostructured materials with unique catalytic properties for renewable energy technologies

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Abstract (300 word limit)

The preparation of nanoscale materials is one of the most exciting areas of modern science and is at the forefront of the quest for a sustainable future. The field of nanotechnology has generated a great deal of interest primarily because on this size scale numerous new and potentially useful properties have been observed. These size dependent properties include melting point, specific heat, surface reactivities, catalytic, magnetic, and optical properties. In particular, the Richards' group is working on new synthetic methods to control the size, shape and composition of nanoscale materials and applying them in systems integral to alternative energy technologies, pharmaceuticals, biomass upgrading, batteries, petrochemicals and environmental cleanup. Recently, the Richards' research group has developed techniques to produce a number of new nanoscale materials that have demonstrated unique catalytic activities through controlled faceting as well as novel intercalation strategies that impart robustness. Here, an overview of the recent highlights regarding these materials and their application in catalytic applications will be presented.

Image

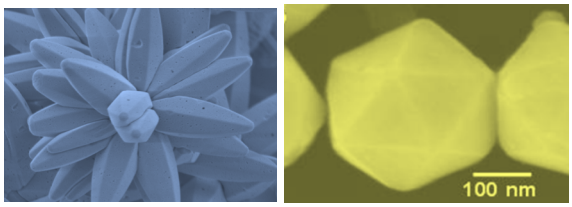


Figure 1. ZnO nanoflower and Au icosahedra

Recent Publications (minimum 5)

1. Feng Lin, Bogdan E Cojocaru, Luke S Williams, Christopher A Cadigan, Chixia Tian, Maria Nicoleta Grecu, Huolin L Xin, Shubham Vyas, Vasile I Parvulescu, Ryan M Richards "Intermediate selectivity in the oxidation of phenols using plasmonic Au/ZnO photocatalysts" *Nanoscale* **2017**, 27, 9359-9364
2. Amy E Settle, Laura Berstis, Nicholas A Rorrer, Yuriy Roman-Leshkóv, Gregg T Beckham, Ryan M Richards, Derek R Vardon "Heterogeneous Diels-Alder-catalysis for biomass-derived aromatic compounds" *Green Chemistry* **2017**, **19**, 3468-3492
3. Mengze Xu, Calvin Mukurakate, Kristiina Iisa, Sridhar Budhi, Malcolm Davidson, David J Robichaud, Mark R Nimlos, Brian G Trewyn, Ryan M Richards "Deactivation of multi-layered MFI nanosheet zeolite during upgrading of biomass pyrolysis vapors" *ACS Sustainable Chemistry & Engineering* **2017,** 5, 5477-5484
4. Samuel H Gage, Brian G Trewyn, Cristian V Ciobanu, Svitlana Pylypenko, Ryan M Richards "Synthetic advancements and catalytic applications of nickel nitride" *Catalysis Science and Technology* **2016**, 6, 4059-4076
5. G. Jeremy Leong, Abbas Ebnonnasir, Maxwell C. Schulze, Matthew B. Strand, Chilan Ngo, David Maloney, Sarah L. Frisco, Huyen N. Dinh, Bryan Pivovar, George H. Golmer, Suneel Kodambaka, Cristian V. Ciobanu, Ryan M. Richards "Shape-directional growth of Pt and Pd nanoparticles" *Nanoscale* **2014**, 6, 11364-11371



Biography (150 word limit) Ryan Richards is a Professor of Chemistry and Associate Vice President for Research at the Colorado School of Mines and holds a joint appointment at the National Renewable Energy Laboratory both in

Golden, Colorado USA. Prof. Richards received his BS from Michigan State University, MS Central Michigan University and Phd from Kansas State University (advisor Kenneth Klabunde). During his Phd studies he was a visiting scientist at the Boreskov Institute of Catalysis in Novosibirsk, Russia. From 2000-2002 he was Max Planck Fellow at the MPI Kohlenforschung in Muelheim, Germany. In 2002 Ryan joined Jacobs University Bremen where he was promoted to associate professor before moving to Mines in 2007. Prof. Richards has published more than 140 papers, 7 patents and has served as editor/co-editor of 3 nanoscience books. He has received numerous awards throughout his career including being selected as a Fellow of the American Chemical Society and 2016 ACS Colorado Section Research Award.

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Notes/Comments:

Invited by John Smith to be member of Advisory Board