

Mechanistic Chemistry at the Atomic Level



Serena DeBeer

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CURRENT RESEARCH

Developing the enzymes necessary for sustainable energy sources

One of the great challenges of energy research is finding ways to efficiently store and release energy from chemical bonds. Metal-based catalysts are one means by which the making and breaking of bonds can be enabled. These can include homogeneous catalysts, heterogeneous catalysts or biological catalysts (or enzymes). Of these catalysts, nature is unsurpassed in its ability to carry out challenging chemical reactions under mild conditions. Further, nature uses earth-abundant metals to catalyze these challenging reactions, meaning that the processes are necessarily sustainable. While the utilization of enzymes in industrial processes is unlikely to be practical, by understanding how the enzymes work, one can obtain the ultimate chemistry lesson from biology and then translate these ideas to rational catalytic design. However, the work of these catalysts occurs at the atomic level and fast times scales. In order to follow these reactions, Dr. Serena DeBeer, of Cornell University and the Max Planck Institute, develops new methods using x-rays to understand mechanistic chemistry on the atomic level. With these x-ray spectroscopic methods, she and her team are able to understand how the metal active centers within the catalysts are able to activate small molecules. Because a sustainable energy economy requires a strong foundation in fundamental science, Dr. DeBeer's research provides a step towards understanding the reactions and ultimately rationally designing catalysts based on mechanistic knowledge.

In addition to the biological processes, Dr. DeBeer also studies the industrial catalysts. In contrast to the biological enzymes, the analogous industrial processes generally require extremely harsh conditions...

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AFFILIATION



Cornell University

EDUCATION

- B.S., in Chemistry, 1995, Southwestern University
- Ph.D., in Chemistry, 2001, Stanford University

AWARDS

- Alfred P. Sloan Research Fellow, 2011
- Kavli Fellow, U.S. National Academy of Science, 2012
- European Research Council Consolidator Grant Awardee, 2013
- Society of Biological Inorganic Chemistry, Early Career Award, 2015

RESEARCH AREAS

Environment, Chemical, Clean Energy

FUNDING REQUEST

Your contributions will support the continued research of Dr. Serena DeBeer, of Cornell University, as she develops new tools to understand mechanistic chemistry on the atomic level. Funding will support the necessary \$200-400K required for building each spectrometer in addition to travel and personnel. While smaller investments of \$10K would allow Dr. DeBeer and her team to begin new experiments, larger donations would continue to have an impact on educating future scientists and building upon the existing technology that they have.