Meeting America's Pressing Needs -- One Reaction at a Time

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Cleaner auto emissions is just one way catalysis research is helping to solve big problems. | Image courtesy of PNNL.

Dr. Steven Ashby
Director, Pacific Northwest National Laboratory

In the Middle Ages, alchemists worked diligently to transform base metals, such as lead, into gold or other precious metals. While these ambitions were without success, medieval alchemy set the stage for modern chemistry.

One trick of the trade today is catalysis, in which a substance – the catalyst – is added to speed the rate of a chemical reaction. Catalysis is central to efficient and cost-effective chemical transformations for numerous manufacturing, energy and environmental applications.

Across the Department of Energy's 17 **National Laboratories**, chemists are at the forefront of this exciting area of science. At **Pacific Northwest National Laboratory**, researchers are pioneering new ways to convert waste to energy, reduce auto exhaust emissions and create fuel cells and batteries for energy generation and storage.

Solving the toughest challenges requires collaboration. Here are just a few examples of how PNNL is teaming with other national laboratories, universities and industry to put chemistry and catalysis to work:

- **Cleaner auto emissions:** PNNL teamed with Argonne National Laboratory, Oak Ridge National Laboratory, Purdue University, University of New Mexico and Fuzhou University to demonstrate how isolated palladium atoms reduce the amount of carbon monoxide emissions released when a car is started – something your current catalytic converter struggles to do until it warms up. This discovery could lead to cleaner air.
- **"Green" chemistry:** In addition to advancing fundamental science, scientists use catalysis to deliver applied solutions – often in collaboration with industry partners. For example, PNNL researchers created a breakthrough catalyst and process to convert glycerol, a low-cost byproduct of biodiesel manufacturing, into propylene glycol, a chemical typically made from petroleum and found in common household products. Archer Daniels Midland Co. licensed the process and, in 2011, built a manufacturing plant in Illinois that today has the capacity to produce 100,000 metric tons of industrial grade propylene glycol a year.
- **Renewable commercial aviation fuels:** PNNL is working with Washington State University and industry to develop low-carbon, renewable fuels for commercial aviation. In this case, the scientific challenge centers on selectively splitting and forming chemical bonds to create molecules needed in aviation fuel. As part of the Federal Aviation Administration Center of Excellence, co-led by WSU and the Massachusetts Institute of Technology, we are now assisting an industry partner in producing and testing a new jet fuel based on our technology.

Recently, Johannes Lercher, Director of PNNL's Institute for Integrated Catalysis, was elected to the prestigious European Academy of Sciences for his advancements in catalyst characterization and discovery. He presented his research this month at the American Chemical Society national meeting. Also recently, a team of PNNL researchers was presented with the American Chemical Society's Lectureship for the Advancement of Catalytic Science. The team uncovered new insights into the important role that proton movement -- and the control of it -- plays in turning electricity into hydrogen fuel. These findings will help advance real-world solutions for storing and delivering energy harnessed from the wind or the sun.

Key to these advancements are PNNL's state-of-the-art (and often unique) scientific instruments and computational resources that enable us to understand and manipulate matter on molecular and even atomic scales. By bringing

these capabilities together with some of our nation's brightest minds, we are well poised to deliver solutions to America's most pressing security, energy and environmental challenges, one reaction at a time.

*Editor's Note: This post was created by **Pacific Northwest National Lab**, one of the Department of Energy's 17 **National Laboratories**.*

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1000 Independence Ave. SW
Washington DC 20585
202-586-5000