



NEW MATERIALS *for* **CLEAN ENERGY TECHNOLOGIES**

What does a successful innovation pipeline look like? It starts with fundamental research into properties of materials important for energy technologies, supported by the Basic Energy Sciences (BES) office of DOE. Potentially important discoveries are passed on to applied research supported by DOE's Energy Efficiency and Renewable Energy (EERE) office, which often partners with or licenses technology to private sector entities. The process usually takes two or three decades, but has repeatedly resulted in the commercialization of new energy technologies.

The Breakthrough

Discovering new materials with superior properties for batteries and fuel cells, and understanding how complex materials could work together to control the amount of sunlight passing through windows.

- Studies using BES-sponsored X-ray facilities to understand the structure of a critical battery part made from manganese, instead of cobalt, proved that the new material would improve battery safety and energy storage capacity, as well as lower costs.
- Similar X-ray studies were undertaken of a novel design—a layer of platinum just one atom thick, deposited on tiny palladium particles—for a critical fuel cell part. The result improved understanding of how fuel cells convert hydrogen into electricity. The new design also improved performance while greatly reducing the amount of expensive platinum needed.
- A decade of research led to understanding how electrical charges move between thin layers of nickel oxide on a glass window, in the process changing the window's optical properties to dim the amount of sunlight admitted. Subsequent applied research developed practical fabrication methods and found that adding tungsten oxide improved the “smart” window effect.

The Impact

Improved batteries and a new automotive powerplant for electric cars, and energy-saving “smart” windows for buildings.

- Improved batteries, now used in the new GM Bolt, are helping jump-start the electric car industry; new fuel cell powerplants that eliminate pollution and avoid battery-recharge downtime, already licensed by GM and other manufacturers, will enable next-generation electric vehicles.
- Commercialization of “smart” windows technology is already well underway, with the potential to save cooling costs in office buildings as well as creating non-glare workspaces.

The Takeaway

Patient fundamental research into the properties of materials leads to insights and new technologies that can transform whole industries and advance the clean energy agenda.

ABOUT THE IMAGES

The hybrid-electric Chevy Volt shown here and the new all-electric Chevy Bolt use batteries that benefited from improved cathode research at Argonne National Laboratory.
(ARGONNE NATIONAL LABORATORY)

These “smart” windows make use of specialized materials to change their tint and lower the amount of sunlight transmitted in response to environmental conditions, saving energy for cooling buildings and creating more comfortable working conditions.
(SAGEGLASS, INC)