Pennsylvania, Penn State, University of Missouri, University of Oregon, University of Washington, and University of Ottawa. Ott is the director of the DOE Chemical Hydrogen Storage Center of Excellence.

The LANL team includes Anthony Burrell, Troy Semelsberger, Ben Davis, Clay Macomber, Himashini Diyabalanage, Roshan Shrestha, and Brian Scott (all MPA-MC); and John Gordon, Andy Sutton, Fran Stephens, Koyal Bhattacharyya, Nathan Smythe, and Ryan Trovitch (all C-IIAC).

The center focuses on the discovery and development of light element molecular chemical hydrogen storage systems for onboard vehicular applications. These materials can rapidly release hydrogen gas at low temperatures and have high gravimetric and volumetric capacities of hydrogen that may potentially meet DOE 2010 technical targets. The center developed and demonstrated more than 120 chemical materials approaches, documented a systematic down-selection process, and made great strides in spent fuel regeneration.

A former MPA-11 postdoctoral researcher, Ludwig Lipp, received an award for fuel cell engineering for advancing the concept of electrochemical compression of hydrogen by increasing both pressure and the number of compression cycles of an electrochemical compressor with a reduced leak rate. Lipp provided comparative market analysis and showed how the technology can meet different DOE program needs going above and beyond project deliverables.

**First soft x-ray photons produced from ultrafast, time-resolved light source**

The ultrafast nanoscale XUV photoelectron spectroscopy team has produced the first photon pulse train as part of its LDRD DR-funded project (see figure). The project’s principal goal is to establish transformational capability in space and time-resolved surface science for exploring complex materials and devices at a resolution approaching the intrinsic time and length scales of matter. This important milestone demonstrates that the team is closer to realizing its goal of producing a capability to understand the nature of electronic structure and dynamics of complex emergent material behavior. George Rodriguez leads the team, which includes Rohit Prasankumar, Georgi Dakovski, Yongqiang An, Quinn McCulloch (all MPA-CINT), Tomasz Durakiewicz, Yinwan Li, Kevin Graham (all MPA-10), Paul Dowden (MPA-STC), and Jian-Xin Zhu and Stuart Trugman (both T-4).

Graph demonstrating the comparable performance of the table-top laser based XUV light source (black line) to synchrotron based data (red line in inset) on a sample of uranium oxide (UO₂). Photoelectron kinetic energy spectrum of UO₂ at room temperature was recorded using a single wavelength selected harmonic with an energy of 32 eV. For comparison, the inset shows the same spectrum of UO₂ recorded using a synchrotron source at 34 eV.

**International collaboration studies high-yield superconducting properties of coated conductors**

LANL and the International Superconductivity Technology Center (ISTEC) in Japan are collaborating on the development and evaluation of superconducting materials for higher irreversibility field (H₁). Materials with higher H₁ are important, since they could expand the region of applications for superconductors. Masashi Miura (ISTEC) has finished a successful two months’ visit to LANL to use the pulsed field capabilities at the LANL National High Magnetic Field Laboratory (NHMFL) to explore the high-field superconducting properties of coated conductors. ISTEC used metal organic deposition to grow epitaxial films of the YBa₂Cu₃O₇ (YBCO) family on flexible metallic tapes for the coated conductors. The scientists are developing effective artificial pinning centers in these films for vortex pinning enhancement. A technique originally developed at LANL, the incorporation of BaZrO₃ (BZO), is among the best worldwide in terms of its potential for power applications due to the high superconducting critical current density (Jc) obtained. In the present study the scientists dispersed BZO nanoparticles as pinning centers in Y(1−x)GdₓBa₂Cu₃O₇ (YGdBCO) coated conductors. The films revealed nearly isotropic Jc angular behavior at low magnetic fields (B < 3 T). The scientists measured the linear electrical transport in the vortex liquid at different

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orientations up to 65 T in pulsed fields at the NHFML to investigate the effect of artificial pinning centers on $H_{irr}$ at high magnetic field. The $H_{irr}$ values of the YGdBCO films with artificial pinning centers were higher than those of YBCO films even at 65 T. The results showed the validity of artificial pinning centers, such as BZO nanoparticles, for enhancement of $H_{irr}$. The work improved our understanding of these high-temperature superconductors. During his time at LANL, Miura collaborated with Scott Baily, Boris Malorov, Jeffrey Willis, and Leonardo Civale (MPA-STC); and Vivian Zapf (NHMFL). Initial results will be presented at the International Superconductivity Symposium in Tsukuba, Japan, and in a manuscript in preparation. The DOE, Office of Electricity Delivery and Energy Reliability, the NHMFL-User Collaborations Grant Program, and the National Science Foundation (NSF) supported the work at LANL.

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\text{Phase diagram of the vortex irreversibility line measured at different magnetic field orientations for YBCO thin films, compared with YGdBCO thin films with BZO nanoparticles.}
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**DOE-EERE holds annual merit review for hydrogen programs**

LANL’s hydrogen fuel cell, production, storage, and codes and standards projects were once again reviewed by peers.

Preliminary feedback from the review of the hydrogen storage program has indicated that LANL’s role as leader of DOE’s Chemical Hydrogen Storage Center of Excellence achieved again the highest rating among all of the storage centers. LANL’s hydrogen storage team that contributes to the center also received the highest project rating across all of EERE’s Hydrogen Storage Program which consists of the approximately 50 storage projects that were presented orally, and an additional 50 projects that were presented in poster format.

The LANL chemical hydrogen storage team is Roshan Shrestha, Ben Davis, Himashinie Diyabalanage, Anthony Burrell, Neil Henson, Michael Inbody, Kevin John, Troy Semelsberger, Frances Stephens, John Gordon, Kevin Ott, Andy Sutton, Koyel Bhattacharyya from C-IIAC, MPA-MC, T-1, and AET-1. The team focuses on storing hydrogen in covalent molecular compounds and materials, processes that evolve hydrogen from such compounds and materials, and also on the chemical regeneration of the spent fuel resulting from dehydrogenation.