Energy, Climate & Infrastructure Security

The Enabling Capabilities program area works to provide a differentiating science understanding that supports the SMU and Sandia's mission technologies now and into the future.

Vision

To enhance the nation's security and prosperity through sustainable, transformative approaches to our most challenging energy, climate, and infrastructure problems.

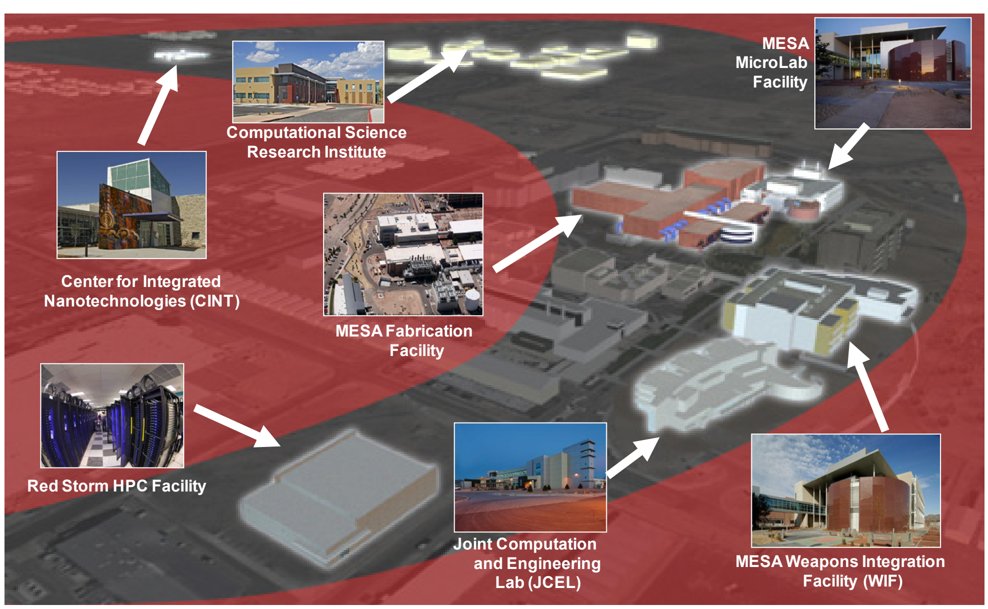
Goal: Deepen fundamental science and engineering competencies in key strategic areas to enable ECIS mission objectives and goals.

Our nation faces looming challenges in energy, climate, and infrastructure security. However, focused, applied research and analysis can only bring us so far. Many of the challenges cannot be solved with improvements to current technologies or extrapolations from them—they require an understanding of the foundational characteristics of materials, energy, and their interactions.

The Enabling Capabilities program area supports this kind of foundational research at facilities such as the

- Center of Integrated Nanotechnologies (CINT),
- Microsystems Engineering, Science, and Applications (MESA) facility,
- Combustion Research Facility (CRF),
- Ion Beam Laboratory (IBL),
- Processing and Environmental Technology Laboratory (PETL),
- Computer Science Research Institute (CSRI), and
- Integrated Materials Research Laboratory (IMRL).

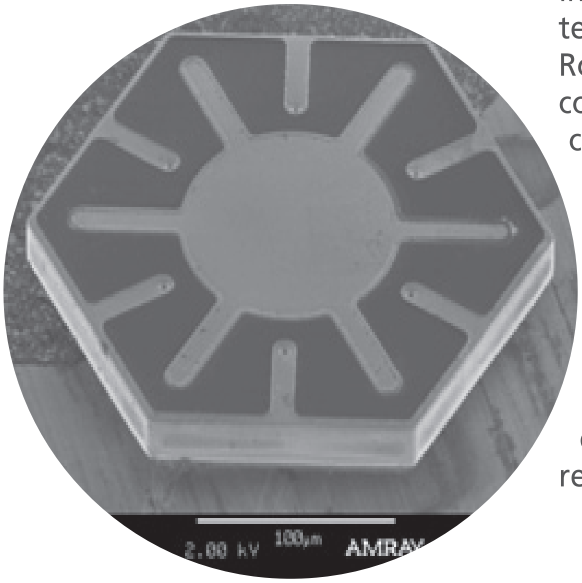
With these facilities, Sandia has extensive, in some cases unique, state-of-the-art laboratory facilities for understanding material growth; fabricating microsystems; semiconductor



Sandia's Innovation Corridor opens up our personnel to greater interactions.

processing; and characterizing structural, electronic, and optical materials. The combination of facilities is unparalleled anywhere in the world. In addition to special lab facilities and equipment, we have cultivated substantial personnel expertise in parallel, over decades, in a broad range of physical science, materials science, and engineering disciplines. This collection of expertise—that can be brought together into large, comprehensive teams—is very rare, and for the most part is simply unavailable elsewhere.

It is through the use of these facilities by our collection of unique scientific and engineering capabilities that we can understand and develop the foundational scientific principles of novel materials and processes into the technology of tomorrow that can surmount the challenges that we face in energy, climate, and infrastructure protection that can secure and sustain our nation.



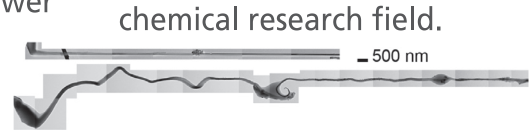
A micrograph of a micro-PV cell.

Solar Glitter

At the MESA complex, Sandia developed tiny glitter-sized photovoltaic (PV) cells that could revolutionize solar energy collection. Cheaper than conventional cells, micro-PV cells are also 10 times thinner, yet perform at about the same efficiency. Micro-PV units could wrap around unusual shapes for solar power integrated into buildings, tents, and even clothing. Rooftop micro-PV modules could have intelligent controls, inverters, and even storage built into the chip—simplifying grid-integration. The tiny solar cells could turn a person into a battery charger—military personnel in the field or backcountry hikers could recharge their electronics as they walk or rest.

Nanoscale Battery Science

The next generations of lithium-ion batteries will use nanostructured electrodes to help increase the power and energy density for electric vehicles and mobile devices. A Sandia team at CINT created the world's first nanoscale battery inside a transmission electron microscope, metaphorically "isolating a tree from the forest." This work allowed for the first time the direct real-time observation of the change in a battery's atomic structure during charging and discharging, and lays the foundation for in situ studies that will have far reaching impact in energy storage, corrosion, and the general chemical research field.



A nanowire battery before (top) and after (bottom) charging: 90% elongation, 35% diameter expansion, 250% volume increase.

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