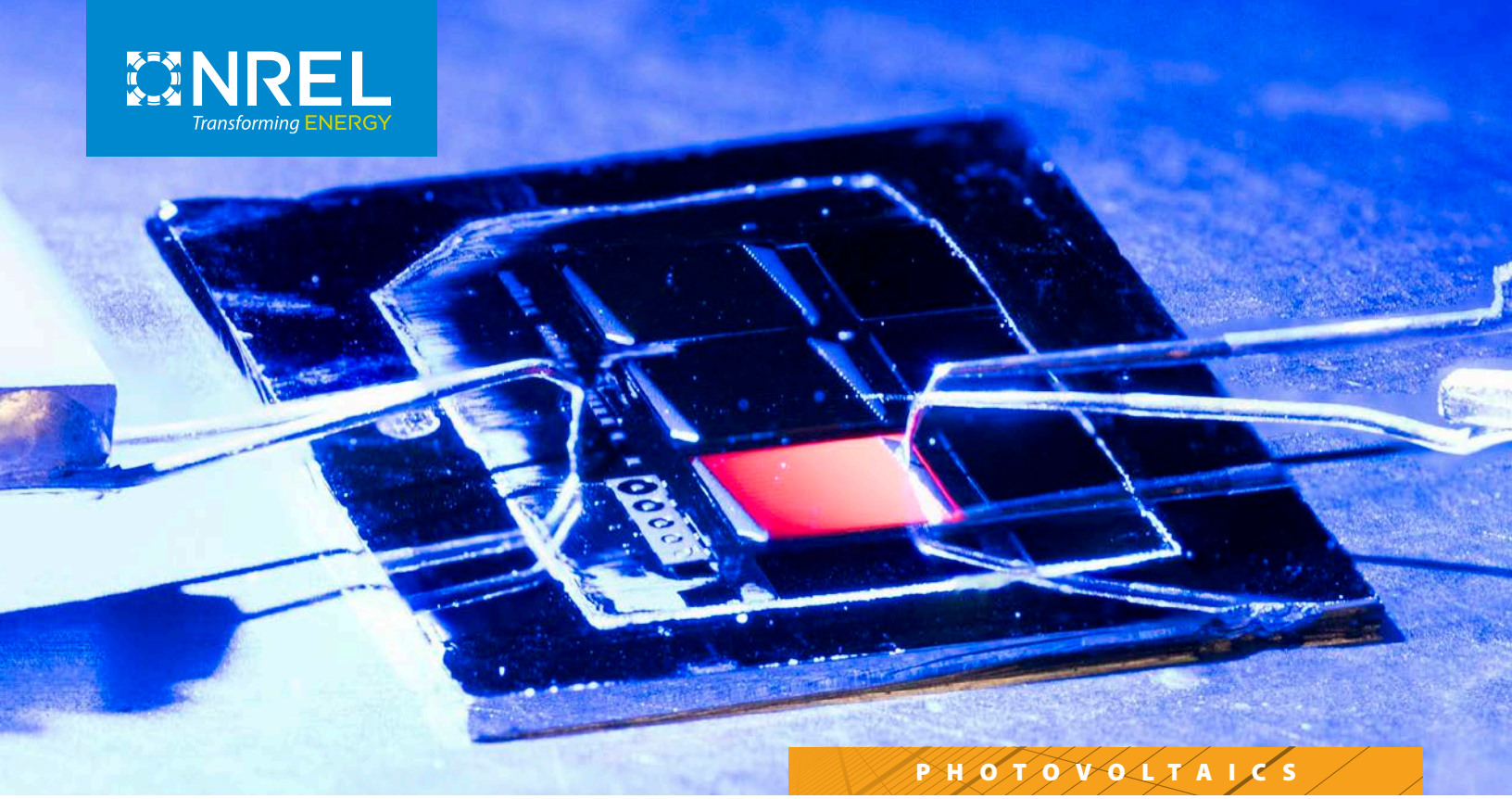


Record-setting monolithic dual-junction solar cell (32.6%) made of all III-V compound semiconductor materials. *Photo by Dennis Schroeder, NREL 44664*

III-V High-Efficiency Multijunction Photovoltaics

NREL's team of world-leading experts in III-V technologies develops advanced multijunction cell technologies and transfers the resulting intellectual property to industry.

The group's distinguished accomplishments include the following:

- Invented the original GaInP/GaAs multijunction cell
- Developed the GaInP/GaAs cell and transferred it to the high-efficiency solar cell industry
- Designed and developed record thermophotovoltaic cells
- Developed, demonstrated, and transferred the inverted metamorphic multijunction cell technology
- Established a six-junction solar cell with world-record efficiency
- Fabricated record-efficiency cells grown by dynamic hydride vapor-phase epitaxy.

NREL addresses the full range of III-V photovoltaics development issues, including:

- Designing new cell concepts for solar, thermophotovoltaic, and power beaming applications
- Developing methods for practically implementing these concepts
- Establishing proof of concept by demonstrating record-efficiency devices at the lab scale
- Exploring lower-cost deposition techniques and solar cell designs
- Creating epitaxial lift-off techniques for substrate reuse.

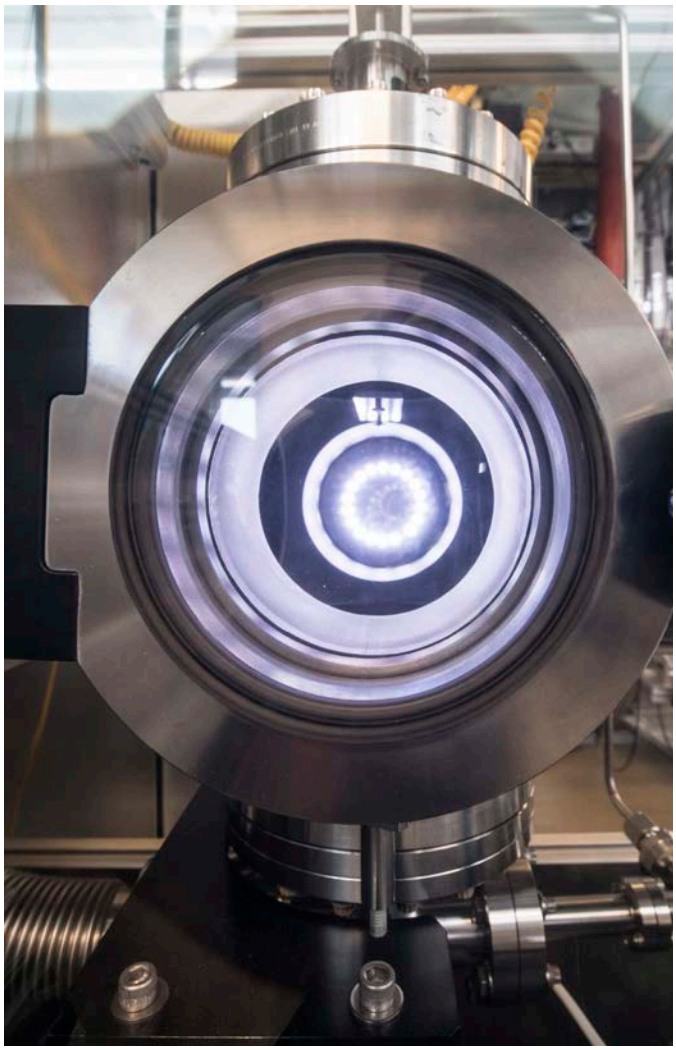
We publish our work in the scientific literature, but also use other mechanisms to transfer this technology to industry partners, including:

- Licensing of our intellectual property
- Establishing Cooperative Research and Development Agreements (CRADAs). In CRADAs, our group works together with an industry partner or government agency to develop the innovations needed to commercialize our technology. We have had CRADA partnerships with virtually all U.S. multijunction industry leaders. Our basic criteria for CRADA projects are the following:
  - Potential for significant impact on the industry
  - Advancement of the technology
  - Strong connection to our group's core competency of multijunction cells.

Core Competencies and Capabilities

The capabilities and tools we bring to bear on developing and transferring multijunction cell technology include the following:

- Cluster tool, which comprises a metal-organic vapor-phase epitaxy (MOVPE) growth system connected via load locks to a molecular-beam epitaxy (MBE) growth system and an analytical chamber
- Two standalone MOVPE growth systems
- Two dynamic hydride vapor-phase epitaxy (D-HVPE) systems
- Clean room in which epitaxial wafers can be processed into full devices
- Suite of cell testing techniques, including current-voltage (I-V), quantum efficiency (QE), external radiative efficiency (ERE), and testing of full multijunction cells under concentrated light
- Numerical modeling of cell performance issues relevant for incorporation into real-world systems, including cell optics, cell heating, and three-dimensional flow of electrical current.



An improved dynamic hydride vapor-phase epitaxy process can produce highly efficient III-V solar cells that could potentially lower current costs by two orders of magnitude. *Photo by Dennis Schroeder, NREL 55196*

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