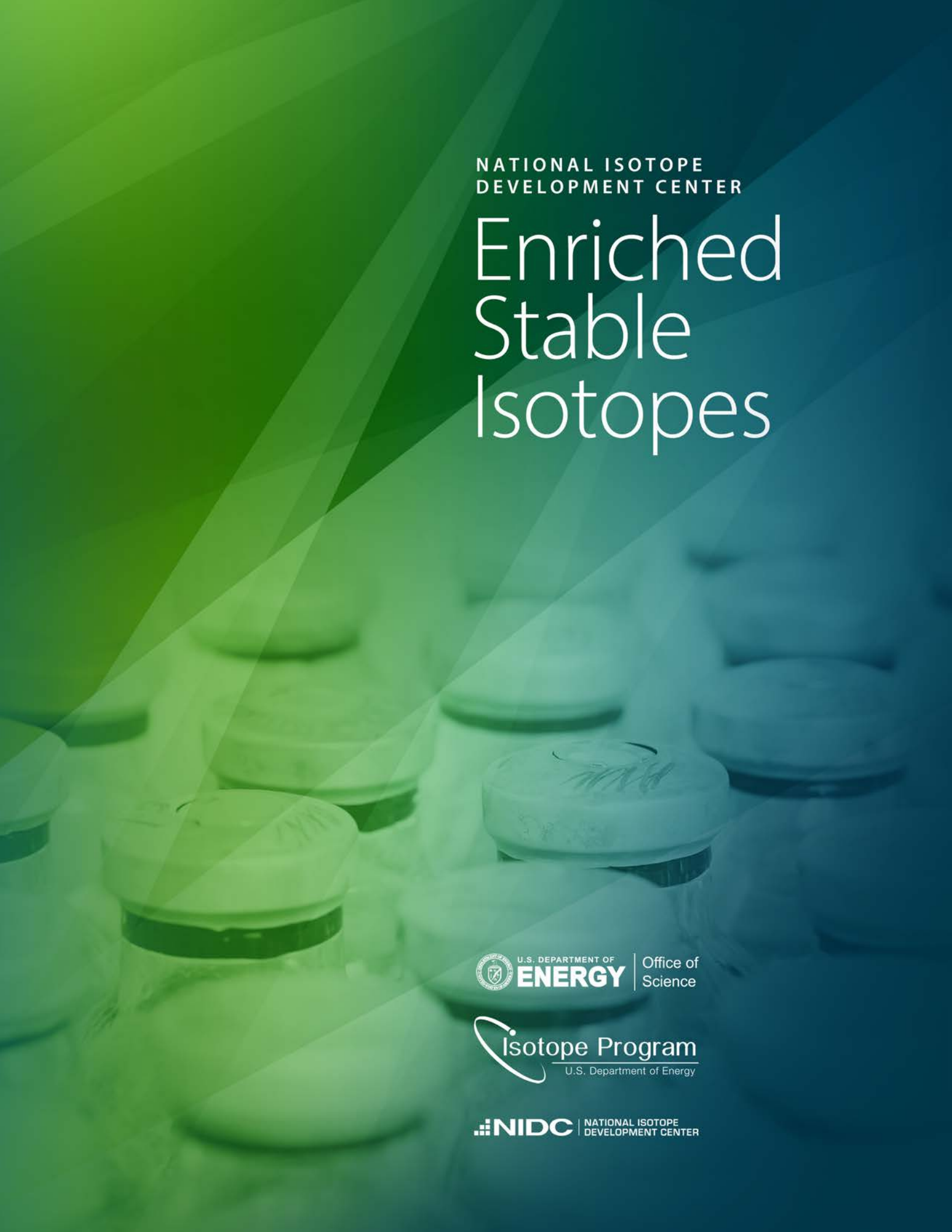
NATIONAL ISOTOPE
DEVELOPMENT CENTER

Enriched Stable Isotopes



U.S. DEPARTMENT OF ENERGY | Office of Science

Isotope Program
U.S. Department of Energy

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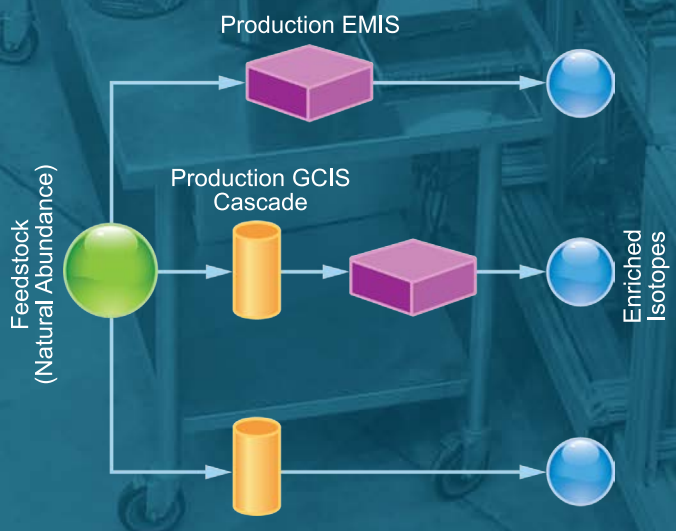
Restoring Domestic Stable Isotope Production

The Enriched Stable Isotope Prototype Plant (ESIPP), funded by the U.S. Department of Energy Isotope Program (DOE IP) and located at DOE's Oak Ridge National Laboratory (ORNL), was completed and began producing enriched stable isotopes in 2017. This plant was equipped with two isotope enrichment technologies based on electromagnetic and gas centrifuge separation and development of prototype equipment began in 2009. As a result, domestic production of a wide range of enriched stable isotopes is now possible to support basic research, medical, national security, and industrial applications. The first production batch of highly enriched isotopes produced by the electromagnetic method was delivered in 2018.

The DOE IP continues efforts to expand stable isotope production capabilities with the Stable Isotope Production Facility project and the Stable Isotope Production and Research Center. The projects aim to expand gas centrifuge production and electromagnetic isotope separator (EMIS) capacity to support annual kilogram-level production for applications requiring large quantities of enriched stable isotopes.

Theoretically, the EMIS system can separate almost any element on the periodic table into individual isotopes. The first step toward separation is to vaporize the element into the gas phase and convert it to an ion beam. The beam is then channeled through a magnetic field, causing ions with different mass-to-charge ratios to bend through different trajectories. The separated ion beams are then focused into separate collection pockets, from which the isotopes are recovered and chemically processed to maximize purity.

Currently, ESIPP can produce research quantities of enriched stable isotopes and is being upgraded to increase the throughput to kilogram quantities for various isotopes. The scalable design of ESIPP can accommodate additional EMIS and gas centrifuge machines, depending on future isotope demand and funding opportunities.



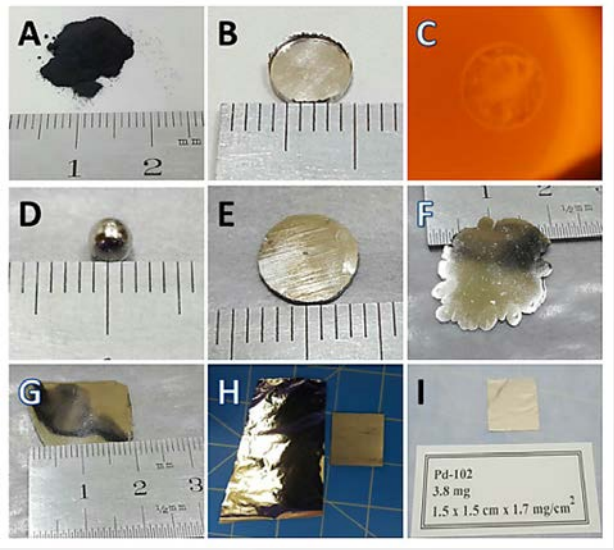
Integrated Approach

Although EMIS can achieve high enrichment for most elements, its throughput is limited (i.e., milligrams to tens of grams annually). Applications requiring both high-enrichment and high-throughput isotope separation are better served by ESIPP's gas centrifuge technology, currently capable of producing several tens of grams annually, depending on the isotope. An ongoing expansion project is expected to increase annual production capacity to kilogram levels. This cascade of gas centrifuges is also an effective way to pre-enrich target isotopes for use as EMIS feedstock.

Electromagnetic isotope separator (EMIS) at ORNL

Large Inventory Available for Dispensing

The DOE IP owns about 250 stable isotopes spanning 59 elements available through the National Isotope Development Center catalog (www.isotopes.gov). The majority of these isotopes were obtained through electromagnetic separation in Manhattan Project–era calutrons. These isotopes have served as feedstock for countless research efforts and applications, and they range in value from less than one dollar to tens of thousands of dollars per milligram. Isotopes are dispensed in inventory form (generally powders) to fill customer orders unless an alternative physical or chemical form is requested, and a lease program is also available for isotopes used in nondestructive research. The dispensing of stable isotopes is managed under an ISO 9001:2015 registered quality management system, helping to ensure consistently high-quality products are delivered to customers.



Transformation of isotope powder to thin foil by ORNL Stable Isotope Group

Tailored Solutions

Many custom-order chemical and materials processing services are available from the ORNL Stable Isotope Group to help address customer needs efficiently and cost effectively. The following capabilities are currently available:

- Inorganic chemical synthesis, metallurgical, ceramic, and high-vacuum processing
- Pyrochemical conversion
- Arc melting, casting, alloying, and drop casting
- Pulse arc welding
- Hot and cold rolling of metal foils
- Inert processing of reactive metals
- Wire casting, rolling, and swaging
- Metal and ceramic powder consolidation
- Vanadium-encapsulated neutron dosimeters
- High-vacuum evaporation
- Diamond abrasive wire sawing
- Ion beam and plasma sputtering
- Target customization
- Transfer of high-purity enriched gases

National Isotope Development Center

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