NATIONAL ISOTOPE DEVELOPMENT CENTER

Managed by the US Department of Energy's Office of Nuclear Physics

A Tri-lab Actinium-225 Research Collaboration Using Accelerators is Making Progress

The alpha-emitting isotopes ^{225}Ac and ^{213}Bi are highly promising as therapeutic radionuclides for use in targeted alpha therapy for cancer and infectious diseases. The highly energetic short-range alpha particles they emit have the potential to kill targeted cells effectively and selectively, delivering a highly cytotoxic dose to cancer cells while minimizing the damage to the healthy tissues surrounding them.

The DOE Isotope Program managed by the DOE Office of Science, Office of Nuclear Physics, is acting to ensure an adequate, reliable supply of ^{225}Ac/^{213}Bi to support medical research and applications. One of the primary barriers to wider use of these isotopes for medical purposes is the lack of an economically viable supply. Currently, the only U.S. source of ^{225}Ac is from the ^{229}Th/^{225}Ac generator at Oak Ridge National Laboratory (ORNL). The medical research demand for the isotope is growing, and the Oak Ridge generator is inadequate to meet the increasing need.

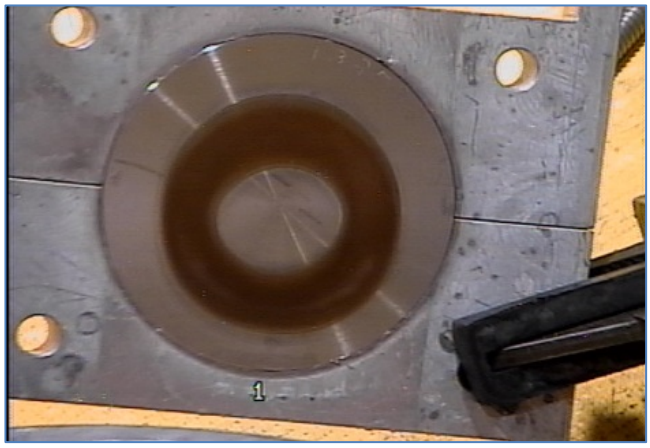
The Isotope Program recently approved a Tri-Laboratory research effort to use charged particle accelerators to produce ^{225}Ac for radio-immunotherapy. The isotope is produced by irradiating a thorium target with a high-energy proton beam. The long-term goal of the Tri-Lab effort is to provide tens of curies of ^{225}Ac to users each year using the accelerator production method. One of the decay daughters of actinium-225 is ^{213}Bi. Both the ^{225}Ac and ^{213}Bi, milked from a generator loaded with ^{225}Ac, are being investigated for therapeutic applications.

The Tri-Lab team is taking advantage of target development expertise and accelerator-production capabilities at Brookhaven National Laboratory's (BNL) Linac Isotope Producer and Los Alamos National Laboratory's (LANL) Isotope Production Facility, along with ORNL's extensive radiochemical processing and purification expertise and experience with processing ^{225}Ac from ^{229}Th.

Until recently, there was only proof-of-concept that the isotopes could be produced effectively in an accelerator. But scientists at LANL and BNL recently completed a successful systematic research effort exploring proton accelerator-based ^{225}Ac production, and the results indicate that the method is viable at the scale needed to support medical use.

In fact, research indicates that it will be possible to match the current annual worldwide availability of ^{225}Ac in just a few days of operations using the accelerators at LANL and BNL.

The ^{225}Ac/^{213}Bi collaborative investigation is now developing high-power targetry and bulk-scale radiochemical processing to potentially provide these isotopes as routinely available medical isotopes. An estimated 2 to 3 years of production scale-up and process development will be required to demonstrate routine, reliable accelerator production of ^{225}Ac.



A 10 g thorium target irradiated at the LANL Isotope Production Facility in support of preliminary ^{225}Ac/^{213}Bi generator.

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The impacts of the various process parameters on the quality of both the final ^{225}Ac product and on the ^{225}Ac/^{213}B generator are being evaluated as part of the Tri-lab collaboration. A key impact that will be assessed relates to the content of ^{227}Ac in the final ^{225}Ac product and how it affects either the direct use of ^{225}Ac or the ^{213}Bi produced from it. Preliminary feedback from the early evaluations shows the ^{213}Bi generators produce a product of equal quality to generators produced by using ^{225}Ac milked from ^{229}Th.The accelerator produced ^{225}Ac also shows similar direct labeling efficiency to that from the ^{229}Th generator.

Studies have shown ^{225}Ac and ^{213}Bi to have particularly significant potential among the alpha emitters suitable for use in cancer therapy. Clinical trials of ^{213}Bi have been conducted for leukemia, lymphoma, malignant melanoma, glioma, and neuroendocrine tumors, and ^{225}Ac is currently in a clinical trial for use against a type of leukemia.

The work is funded by the DOE Office of Science through the Isotope Development and Production for Research and Applications program in the Office of Nuclear Physics.

DOE's SULI Program Inspires a Career in Nuclear Chemistry

Becky Lewis's start in nuclear chemistry wasn't planned. As a sophomore at Northeastern University in 2012, she was looking at potential co-op positions for the spring—a paid, six-month position that would hopefully help her to decide what area of chemistry she wanted to pursue. She decided to apply to the Student Undergraduate Laboratory Internship (SULI) Program through the Department of Energy (DOE) Office of Science (SC). Becky had heard about SULI from a family member and was interested in the opportunity to work at a national laboratory while still an undergraduate.

The chance to do research at a national laboratory made it hard to turn down the offer she received from SULI, and Becky had gotten excited about her proposed project.

Her assignment was to work with Julie Ezold on organizing the isotope inventory for the Radiochemical Engineering Development Center at Oak Ridge National Laboratory (ORNL). This meant Becky, who was only an undergraduate, would be working with and learning about radioisotopes, including the actinides. She accepted the position and moved to Tennessee in January 2012.

Beyond working on the inventory, Becky did a research project on gamma spectroscopy, a radioanalytical technique that she hadn't even heard about until her internship. This project, mentored by Dr. Rose Boll of ORNL's Nuclear Materials Processing group, tied in nicely with Becky's inventory work. Becky used the calculations she had made of the activity of each sample during the inventory as a comparison with the activities she measured using gamma spectroscopy.

As part of the SULI experience, Becky gave an oral presentation on her research progress about halfway through the program and presented a poster of her work at the end. She had never had to design or present a poster before, and in the process she realized just how much she had learned during her internship. Becky had discovered a whole new field and she decided that was where she wanted to be.

Becky later went to graduate school to study Nuclear Chemistry as a result of her experience through the SULI program.

"Three years ago I didn't even think I was going to graduate school, but here I am," she says. "My exposure at Oak Ridge opened up so many opportunities that I never would have discovered on my own, and allowed me to decide where I wanted to go with my degree and my interests."

SULI Program (continued)

"I realize that it's not easy for most undergraduates to take a semester off to participate in a program like this, but there are always summers and even the year after graduation. I think it's important to go out and try something before deciding what you want to do in graduate school. The SULI program is a great way to get experience, especially because it removes you from your normal environment and allows you to focus on developing new skills and learning new fields. I encourage everyone to go try things, even if it was off your radar yesterday, because you never know what might be a perfect fit."

DOE regularly offers programs for students interested in science fields. Most of these programs can be found on the DOE Office of Science Workforce Development for Teachers and Scientists website (http://science.energy.gov/wdts/). DOE's 17 national laboratories provide a unique opportunity for science, technology, engineering, and mathematics (STEM) workforce development. The national laboratory system offers access to leading scientists; world-class scientific user facilities and instrumentation; and workforce and large-scale, multidisciplinary programs unavailable in universities or industry. The DOE laboratories provide a number of opportunities for STEM training and education, annually providing programs for more than 250,000 K-12 students, 22,000 K-12 educators, 4,000 undergraduate interns, 3,000 graduate students, and 1,600 postdoctoral researchers. For more information please contact sc.wdts@science.doe.gov.

Becky Lewis at Oak Ridge National Laboratory

DOE Isotope Program Booth a hit at the Pacific Basin Societies Conference!

The DOE Isotope Program was represented at this year's PACIFICHEM conference in Honolulu, Hawaii. PACIFICHEM is jointly sponsored by the American Chemical Society, the Canadian Society for Chemistry, the Chemical Society of Japan, the New Zealand Institute of Chemistry, the Royal Australian Chemical Institute, the Korean Chemical Society, and the Chinese Chemical Society. This year's conference was the seventh in a series held every five years in Hawaii. Along with the exhibition booth, the DOE Isotope Program held a symposium on isotope production, organized by Dr. Dennis R. Phillips, which covered topics of providing important material for research and applications.

Recently the DOE Isotope Program also displayed the booth at the Society of Nuclear Medicine and Molecular Imaging (SNMMI) Annual Meeting in Baltimore, MD. Attendance at these meetings is one way the DOE Isotope Program provides an opportunity for users and researchers in the isotope community to learn about products available from the DOE program and provide feedback on materials received or new isotope products needed in their research or industrial applications.

The DOE Isotope Program Booth at SNMMI

New Preferred Customer Tools for Stable Isotope Researchers

The DOE Isotope Program recently announced the release of new website tools for NIDC Preferred Customers within the Online Catalog of Isotope Products at https://www.isotopes.gov/. The new website capabilities will allow NIDC Preferred Customers to securely generate quotations for selected stable isotope products in inventory and process them into online orders for an approved research application and delivery within the U.S. These tools will also allow for tracking of online order status, exporting of orders into an Excel format, browsing the history of orders for their associated institution, and updating of the NIDC Preferred Customer profile.

If you qualify for the Preferred Customer status, this tool can make your quote and order process more efficient. To apply for NIDC Preferred Customer status, you must be a researcher or administrator from a U.S. research institution or university and complete the online application at https://isotopes.gov/catalog/apply.php. Once your application has been reviewed and accepted by NIDC staff, you will receive an email with detailed instructions concerning your access to these new website tools.

If you have questions or need additional information, please contact the NIDC.

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