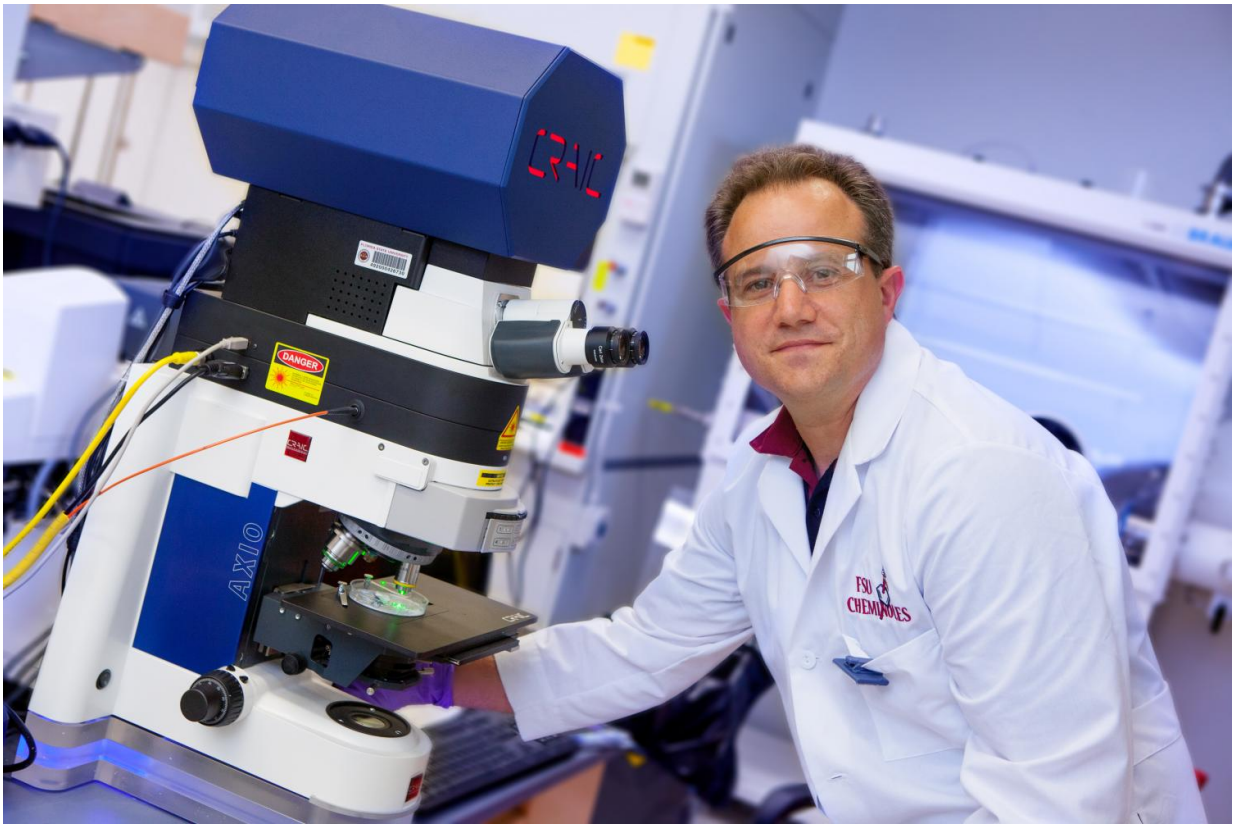
Chemists explore outer regions of periodic table

August 25 2016



Thomas Albrecht-Schmitt has worked on the heaviest elements of the periodic table, including berkelium. Credit: Bill Lax/Florida State University

A little known—and difficult to obtain—element on the fringes of the periodic table is broadening our fundamental understanding of

chemistry. In the latest edition of the journal *Science*, Florida State University Professor Thomas Albrecht-Schmitt captures the fundamental chemistry of the element berkelium, or Bk on the periodic table.

"What this really gives us is an understanding of how chemistry is changing late in the table," Albrecht-Schmitt said. "The purpose is to understand the underlying chemistry of the element. Even after having it for almost 70 years, many of the basic chemical properties are still unknown."

Berkelium, discovered in 1949, resides at the very end of the periodic table among a group of elements called the actinide series. These elements are some of the heaviest, yet least understood chemical elements on Earth.

In a series of carefully choreographed experiments both at his specialized lab and at the FSU-based National High Magnetic Field Laboratory, Albrecht-Schmitt made a berkelium borate compound and a complex berkelium molecule in the form of crystals, and also completed a series of measurements of the element to better understand its structural and chemical similarities to surrounding elements such as californium (Cf) and Curium (Cm).

Through this process, Albrecht-Schmitt found that that berkelium was very similar to its periodic table neighbor californium in its structure, but chemically it had some significant differences.

"It's electronically different than what people expected," he said.

The crystals Albrecht-Schmitt and his colleagues made developed such a positive nuclear charge that they started fragmenting shortly after they were assembled.

"We didn't anticipate it," he said. "We just saw these tiny crystals exploding."

Berkelium has been mostly used to help scientists synthesize new elements such as element 117, tennessine, which was added to the table earlier this year. But little has been done to understand what the element alone can do and how it functions.

Albrecht-Schmitt's lab is a novelty in the world of university science. His chemistry lab is specifically designed to handle radioactive elements like berkelium, making it the only university lab in the country equipped to do so. Because of this, the Department of Energy has worked with him extensively on research that illuminates the far regions of the periodic table.

The department has also recently awarded him $10 million as part of its Energy Research Center program so he can investigate new technologies to recycle nuclear waste and cleanup Cold War-era weapon production sites.

His previous work showed that the element californium had unique properties and represented a break in the periodic table to a new kind of chemistry that had not been observed before.

The Department of Energy gave Albrecht-Schmitt 13 milligrams of berkelium, roughly 1,000 times more than anyone has used for a major research study. To run experiments though, he had to move quickly. The element reduces to half the amount in 320 days, at which point it is not stable enough for experiments.

"Because it is so radioactive, there is never much available," Albrecht-Schmitt said. "We had to capture the chemistry before nuclear decay destroyed the samples."

Researchers will be following up on this with work on additional berkelium compounds that they were able to make in the lab.

More information: "Characterization of berkelium(III) dipicolinate and borate compounds in solution and the solid state" *Science*, science.sciencemag.org/cgi/doi … 1126/science.aaf3762

Provided by Florida State University