Characterizing a crystal structure of a californium metallocene

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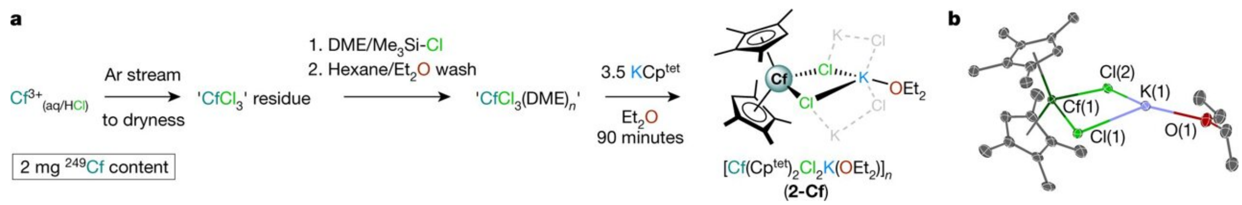

Fig. 1: Synthesis and solid-state structure of 2-Cf. Credit: DOI: 10.1038/s41586-021-04027-8

A team of researchers working at Los Alamos National Laboratory in New Mexico has successfully characterized a crystal structure of a californium metallocene. In their paper published in the journal *Nature*, the group describes their carefully orchestrated process and the characteristics of the crystal structure they created. Julie Niklas and Henry La Pierre with the Georgia Institute of Technology, give an overview of the history of actinide metallocene study and outline the work done by the team in New Mexico in a News and Views piece published in the same journal issue.

Californium is the heaviest actinide element and is both rare—it does not exist in nature—and highly radioactive. For these reasons, little research has explored the element to understand its characteristics or possible applications. In this new effort, the researchers wanted to learn more about how something new might be made using the element—in this instance, a crystal structure. They first had to design a strategy to do so that would be safe. To that end, they first created and used models to predict what would happen as they carried out steps in a characterization process.

The first thing they learned was that the process had to be done quickly because of concerns regarding the radiolytic decay of the rare element, resulting in damage to samples. Thus, they learned that their process had to be carried out in just a single day. They also ran their models and later experiments using other, similar elements because they were so much easier to obtain. They also tested their ideas using americium-241 because its energies are similar to californium. The researchers also put into place standard procedures for handling highly radioactive materials, and chose to conduct their experiments with very small amounts of californium.

Once everything was in place, the researchers carried out their characterization process and found it produced a "bent" crystal structure, $Cf(Cp^{tet})_2Cl_2K(OEt_2)_n$ —the bend was due to the way its two organic ligands twisted away from the parallel portion of the crystal to make room for the Cf^{3+} ions.

More information: Conrad A. P. Goodwin et al, Isolation and characterization of a californium metallocene, *Nature* (2021). DOI: 10.1038/s41586-021-04027-8

Julie E. Niklas et al, Californium—carbon bond captured in a complex, *Nature* (2021). DOI: 10.1038/d41586-021-03385-7