

The Gaiser group's focus will be on benefiting society through both the study of relevant radiotherapy isotopes for medical use and the study of *f*-block elements targeting the energy crisis and better storage of spent nuclear fuel.

Radium will be a main target within the relevant radiotherapy isotopes. Despite radium being an FDA-approved targeted alpha therapy treatment for bone metastasized cancers, there is a significant dearth of information surrounding its structure and bonding. Developing the fundamental chemistry of radium through determining its preferred coordination and bonding environment will guide the intelligent design of a chelating system constructed for radium. A chelator specific to radium would allow biological targeting outside of where radium naturally accumulates — in the bones; thus, being able to target cancers beyond bone metastasized cancers. The Gaiser group's goal to study radium in both the solid and solution states will elucidate these unknowns of radium, which have yet to be determined due to radium's high radioactivity and daughter product of gaseous radon. The vast experience working with radioactive material of the Gaiser Group and the safety guidelines Michigan State University has in place allows for this research to be safely performed. Together, through synthesis and characterization of various radium complexes, a targeted chelating system may be designed and employed to direct radium to other parts of the body as opposed to where it naturally accumulates, in the bones.

The beam dump at FRIB will constantly be generating promethium-147. This isotope has not only shown promise as a PET imaging and beta-therapy isotope, but also within nuclear batteries as a nonthermal converter. Through optimizing the purification of promethium from the beam dump, promethium may be

isolated to begin to understand the chemistry of this exclusively radioactive lanthanide. The isolation of promethium may be beneficial toward a future of commercializing promethium batteries. Promethium-147 is a choice option as a nonthermal converter as it decays purely through beta emission and has extremely low intensity gamma lines, all easily shielded within a battery. Additionally, since promethium is the only exclusively radioactive lanthanide, there is a deep lack of knowledge surrounding its chemistry particularly compared to the rest of the lanthanides. There are many examples of trends within the lanthanide series, where missing the experiment with promethium results in a rather large gap. The isolation of promethium will allow for its fundamental chemistry to be developed, these gaps in lanthanide trends to be filled, and potentially other uses discovered. Furthermore, the foundation of promethium purification, mainly from its neighboring lanthanides—neodymium and samarium—may shed light on their actinide size analogs—americium and curium. Establishing a reliable separation of americium and curium on an industrial scale continues to be one of the larger challenges facing the cleanup and storage of spent nuclear fuel; therefore, targeting the separation of promethium without manipulating oxidation state may also aid in solving the americium and curium separation issue. ♡



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### SELECTED PUBLICATIONS

*Creation of an unexpected plane of enhanced covalency in cerium(III) and berkelium(III) terpyridyl complexes*, A.N. Gaiser, C. Celis-Barros, F.D. White, M.J. Beltran-Leiva, J.M. Sperling, S.R. Salpage, T.N. Poe, D. Gomez Martinez, T. Jian, N.J. Wolford, N.J. Jones, A.J. Ritz, R.A. Lazenby, J.K. Gibson, R.E. Baumbach, D. Páez-Hernández, M.L. Neidig, T.E. Albrecht-Schönzart, *Nat. Commun.* **2021**, 12(1), 7230.

*Examination of Structure and Bonding in 10-Coordinate Europium and Americium Terpyridyl Complexes*, White, F.D.; Gaiser, A.N.; Warzecha, E.J.; Sperling, J.M.; Celis-Barros, C.; Salpage, S.R.; Zhou, Y.; Dilbeck, T.; Bretton, A.J.; Meeke, D.S.; Hanson, K.G.; Albrecht-Schmitt, T.E., *Inorg. Chem.* **2018**, 57 (20). <https://doi.org/10.1021/acs.inorgchem.8b02085>.

*Structural and Spectroscopic Investigation of Two Plutonium Mollitates*, Sperling, J. M.; Gaiser, A.N.; Windorff, C.J.; Klamm, B.E.; Whitefoot, M.A.; Chemey, A.T.; Long, B.N.; Campbell, J.G.; Albrecht-Schmitt, T.E., *Inorg. Chem.* **2020**, 59 (5), 3085. <https://doi.org/10.1021/acs.inorgchem.9b03432>.

*Compression of Curium Pyrrolidine-Dithiocarbamate Enhances Covalency*, Sperling, J.M.; Warzecha, E.J.; Celis-Barros, C.; Sergentu, D.C.; Wang, X.; Klamm, B.E.; Windorff, C.J.; Gaiser, A.N.; White, F.D.; Beery, D.A.; Chemey, A.T.; Whitefoot, M.A.; Long, B.N.; Hanson, K.; Kögerler, P.; Speldrich, M.; Zurek, E.; Autschbach, J.; Albrecht-Schönzart, T.E., *Nature* **2020**, 583 (7816), 396. <https://doi.org/10.1038/s41586-020-2479-2>.

