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Improving the selective extraction of spent uranium in nuclear waste clean-up

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Driven by the need to find ways of separating, recycling and reducing nuclear waste, chemists at The University of Nottingham are developing our understanding of how uranium interacts with elements from around the periodic table to potentially help improve the selective extraction of spent uranium in nuclear waste clean-up.

Nuclear power could produce far less carbon dioxide than fossil fuels, but the waste it produces is potentially some of the most dangerous in the world. Driven by the need to find ways of separating, recycling and reducing nuclear waste, chemists at The University of Nottingham are developing our understanding of how uranium interacts with elements from around the periodic table to potentially help improve the selective extraction of spent uranium in nuclear waste clean-up.

Stephen Liddle, Professor of Inorganic Chemistry and Royal Society University Research Fellow and one of the stars of the Periodic Table of Videos, said: "We need to reduce the volume of nuclear waste to make it easier to handle, and process it to remove benign elements or separate the high level waste from low level waste. This latest study looked at how soft elements such as arsenic interact with uranium—arsenic could in principle be used in organic molecules that bond to metal atoms and improve extraction processes."

The research, which was carried out by an interdisciplinary team in the School of Chemistry and The Universities of Manchester and Regensburg, is published today Monday 15 June 2015, in *Nature*

Chemistry.

Professor Liddle said: "There is currently a lot of interest in using organic molecules to extract, selectively, metal ions from the 'soup' of nuclear waste and fish out the 'bad' ones and leave the rest behind. This requires an understanding of chemical bonding and how the organic extractants bind to different metals. We can then exploit this knowledge to achieve separation by having them selectively bind to one type of metal and remove it from the soup.

Evidence is mounting

There is mounting evidence that the molecules that are best at this contain soft donor atoms to the metals, so we need to understand soft donor-to-metal binding better. Arsenic is a soft donor. So, using Arsenic, which occurs naturally in many minerals, we have created model complexes to understand the nature of the bonding. We might be able to use this new knowledge and understanding in a real system in the future."

Professor Liddle's work has already been highlighted in the scientific media such as Science, Nature family, Chemistry World, Chemical and Engineering News and Chemistry in Australia. Professor Liddle also appears frequently on the School of Chemistry's Periodic Table of Videos

Outstanding research has gone from strength to strength

Professor Liddle's research in this field dates back to November 2009 when he was recognised for his outstanding and creative early career research with a £890,000 Starting Independent Research Grant (StG) by the newly established European Research Council (ERC) to study speculative and ground-breaking research into molecular depleted uranium chemistry uranium.

In January 2014 he was awarded The Consolidator Grant (CoG) from the European Research Council (ERC) £2m to develop his research at the frontier of fundamental molecular uranium chemistry.

His group's search for cleaner, low temperature nuclear fuels led to their 'trophy molecule' breakthrough published in *Science* in June 2012. And another surprise came in May 2013 when they identified the previously unknown bonding properties within the molecule. The research was published in *Nature Chemistry* in May 2013.

More information: "Triamidoamine uranium(IV)–arsenic complexes containing one-, two- and threefold U–As bonding interactions." *Nature Chemistry* (2015) DOI: 10.1038/nchem.2279

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