Nuclear Security Science Network







Consortium for Monitoring, Technology, and Verification



Science and Technology **Facilities** Council

From Radiochemical Synthesis to Separations at the Edge of the Periodic Table

Rebecca Abergel **University of California - Berkeley**

UK-US Academic Network in Nuclear Security and Nonproliferation Skills Virtual Workshop

Probing Fundamental Radiochemical Properties



Detection and Separation (Fuel Cycle, Critical Materials)



Decontamination and Remediation

CBRN threat

Medical Applications (Molecular Imaging & Therapy)







Targetry and **New Element Discovery** Energy Production (RTG)





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Radionuclide-Specific Chemical Sequestration

- Detection
- Characterization
- Separation
- Immobilization



TALSPEAK

PUREX

Molten Salts Fuel Degradation

Stability Trends and Charge Selectivity



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Sturzbecher-Hoehne M. et al., Chem. Eur. J. 2014Sturzbecher-Hoehne M. et al., Dalton Trans. 2011Sturzbecher-Hoehne M. et al., Inorg. Chem. 2015

Unprecedented Charge-Based Separation



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Nat. Comm. **2019**, 10, 1-9

Controlling the Oxidation State of An Ions





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Read Online

Cite This: Inorg. Chem. 2021, 60, 973–981

Inorg. Chem. **2021**, 60, 973-981 Chem. Eur. J. **2020**, 26, 2354-2359

 $\leftarrow \rightarrow Bk(IV)$

Bk(III)

PUREX: Reduction of Np(V) to Np(IV)



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Sep. Purif. Technol. 2021, 259, 118178

TALSPEAK-Like An/Ln Separation at Low pH



Hydroxypyridinone Derivatives: A Low-pH Alternative to Polyaminocarboxylates for TALSPEAK-like Separation of Trivalent Actinides from Lanthanides

Yufei Wang,[§] Gauthier J.-P. Deblonde,[§] and Rebecca J. Abergel*

Cite This: ACS Omega 2020, 5, 12996–13005 Read Online

Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er La Tm Yb Lu lantanio lutezio Ac Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr torio curio attinio uranio nettunio plutonio berkelin californin

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ACS Omega. 2020, 5, 12996-13005

A₂NalO₆ Periodate Double Perovskites (A= Sr, Ca, Ba) (UNLV-U. Sheffield)

- Candidate wasteform for I-129 immobilization
- Experiment theory collaboration
 - Synthesis & Characterization (N. Hyatt, U. Sheffield)
 - Computational modeling (E. Kim, UNLV)
- 2 PhD students
 - S. O'Sullivan (U. Sheffield); E. Montoya (UNLV)
- 2 Undergraduate students
 - J. George (UNLV); C. Kirk (UNLV)





Expected Impact

- Fundamental understanding of radiochemical properties
- Development of state-of-the-art techniques for characterization
- Development of new reprocessing methods
- Development of new on-line diagnostics methods
- Development of new wasteforms
- Training of next generation radiochemistry workforce

Conclusion and Next Steps

- Development of chemical structures to control the chemical properties of various radionuclides of interest
- Extend to Th/Pa separation in molten salts
- Investigate radiolytic stability
- Process engineering at scale
- Couple separations with optical spectroscopy and mass spectrometry
- On-line diagnostic, forensics analysis
- Opportunities for collaboration

