

Extraction Chromatographic Studies of Rf Homologs Using Crown Ether Based Resins

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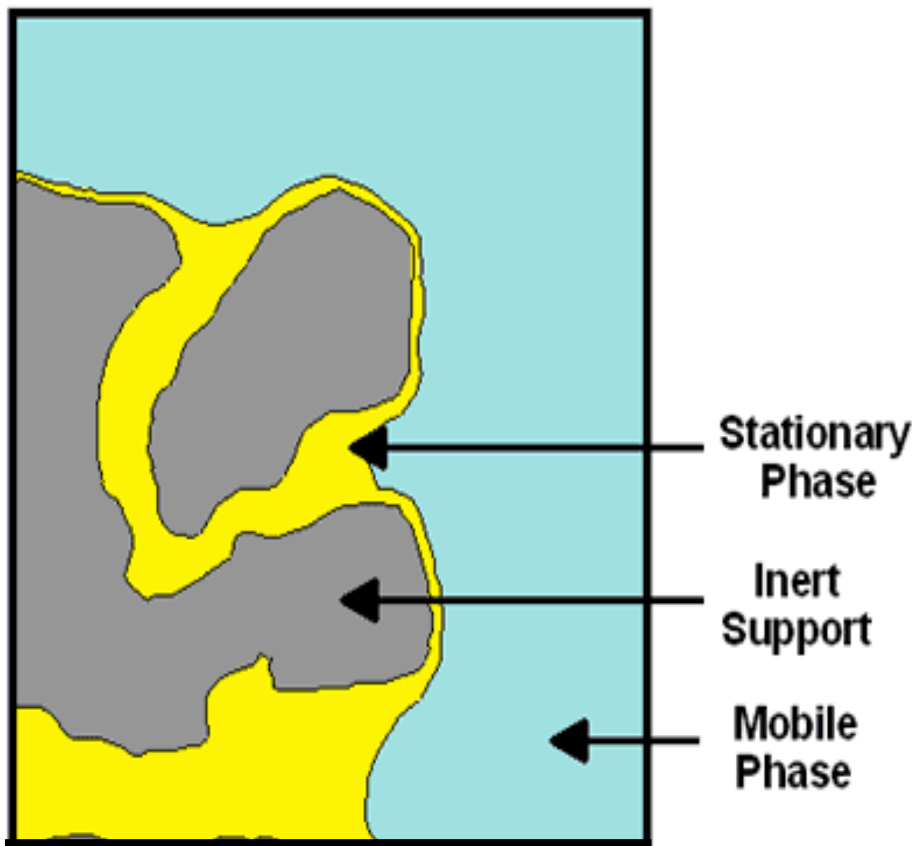
Separation Requirements

- Rapid
- Large number of exchange steps
- Highly Selective for separation between homologs
- Preferably a continuous process
- Samples easily prepared for α spec

**Extraction Chromatography
fulfills all of these**

Extraction Chromatography¹

Surface of Porous Bead

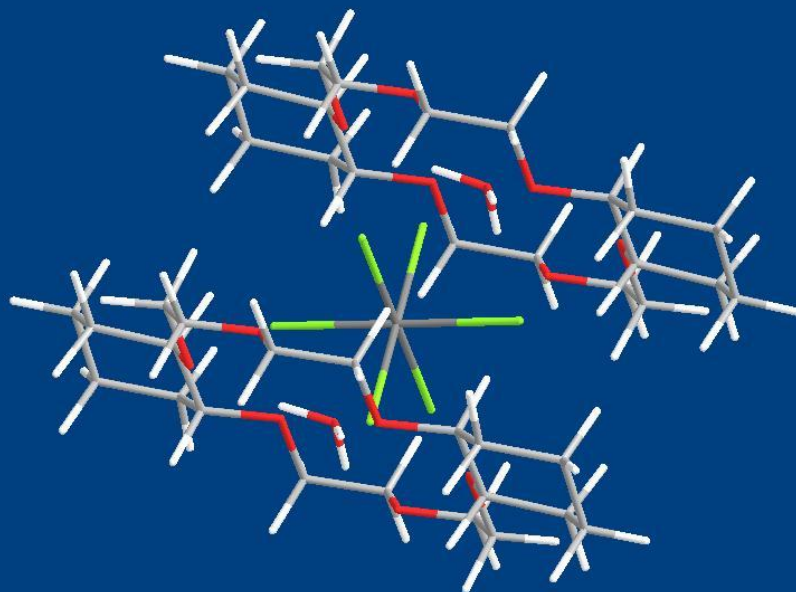


$$D_w = \frac{A_r}{m_r} \div \frac{A_s}{v_s}$$

$$A_r = A_o - A_s$$

<http://www.eichrom.com/products/extraction.cfm> November 2009

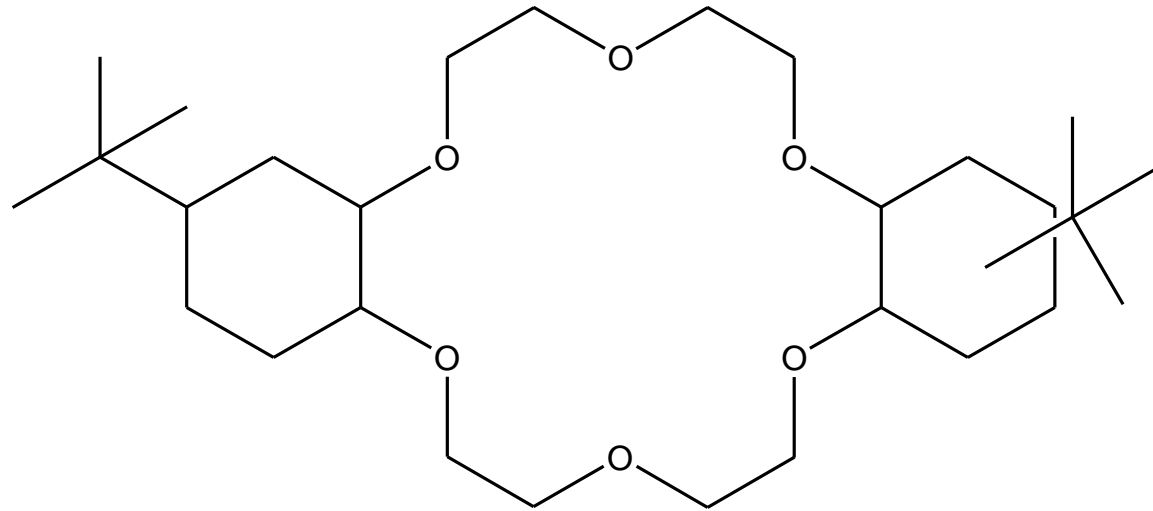
Why Crown Ethers?



Courtesy of Ralf Sudowe

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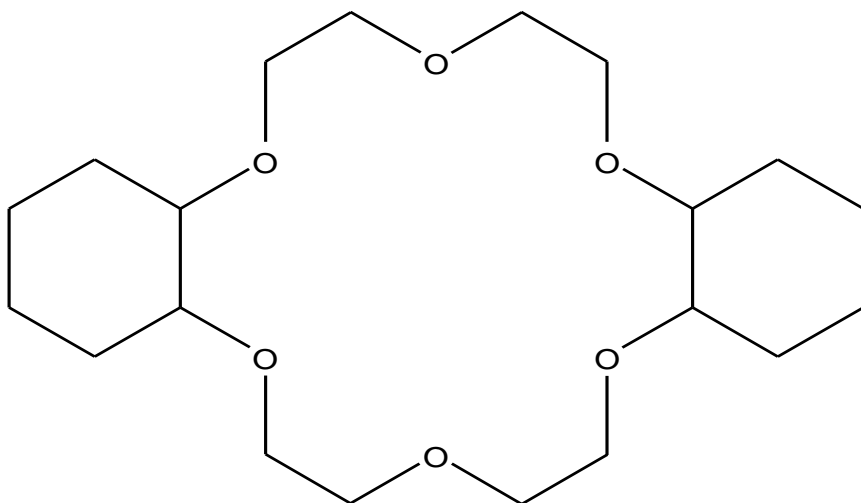
Previous Work – Commercially Available Resins



- No difference in separation of Zr and Hf due to:
 - [Crown Ether]
 - Solvent (octanol and decanol)

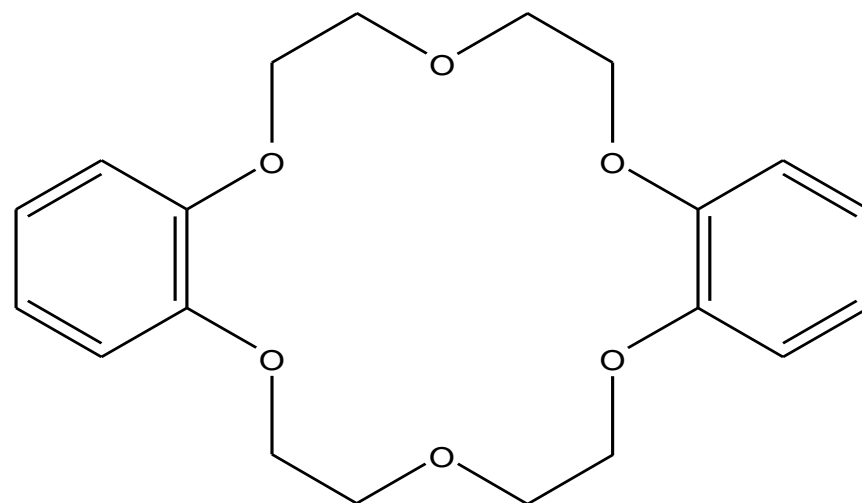
In House Synthesized Resins

radi ochemistry



In house DC18C6 Resin

- ~0.75 M DC18C6
- Various solvent
- Free resin



In house DB18C6 Resin

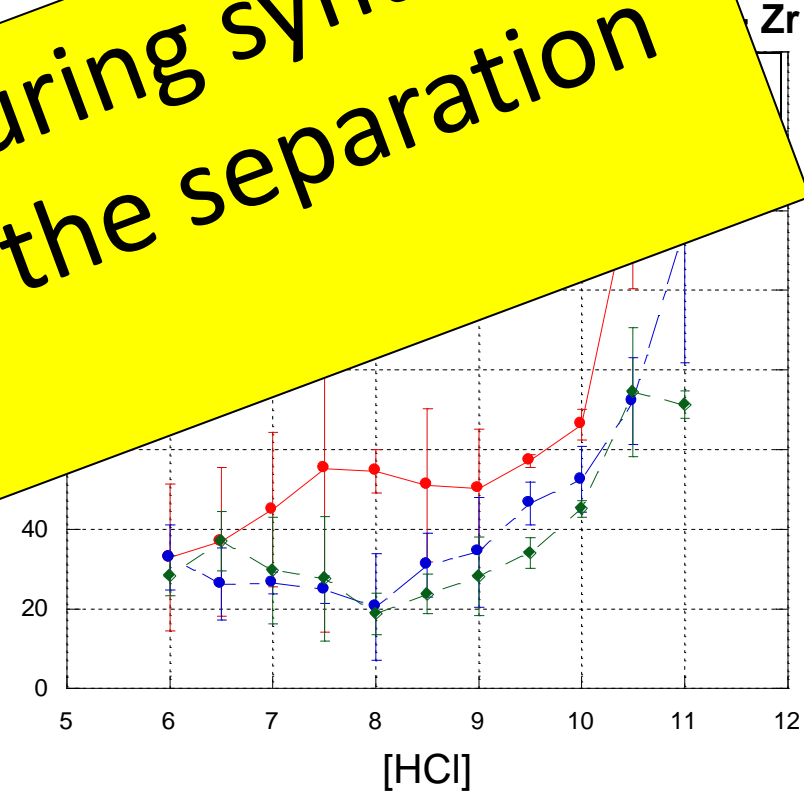
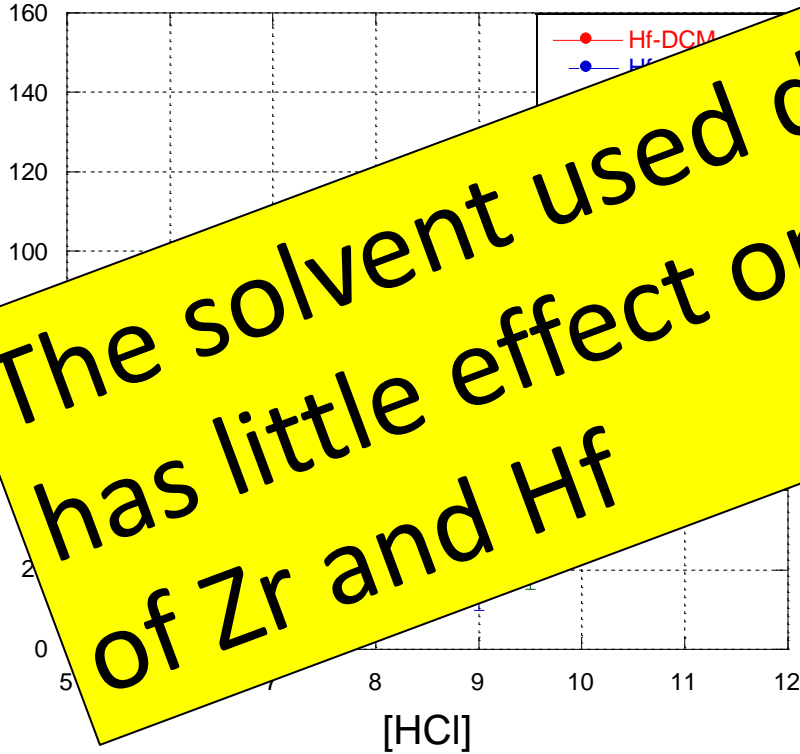
- ~0.75 M DB18C6
- dichloromethane solvent
- Free resin

Solvent Effect

Solvent Effect

radiation chemistry

0.75M DC18C6 in Various Solvents - Hf

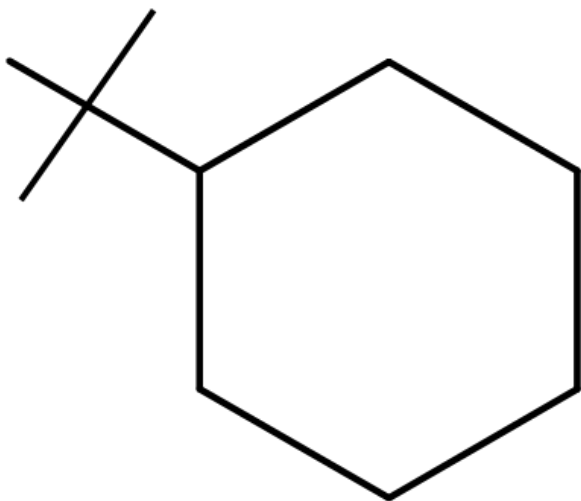


The solvent used during synthesis has little effect on the separation of Zr and Hf

Functional Group Effect

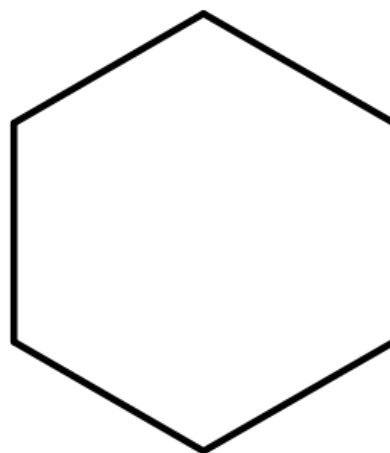
Functional Groups

radiation chemistry



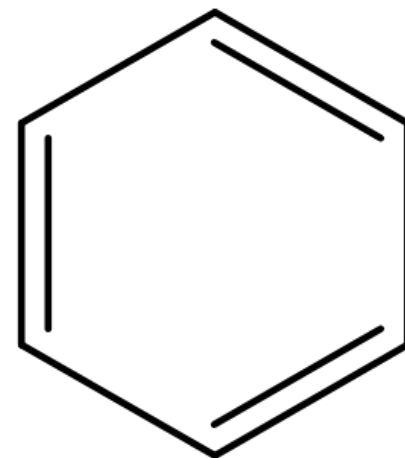
Eichrom's Pb Resin

- ~0.75 M DtBC18C6
- 1-Octanol solvent
- Free resin
- 2 mL pre-packed



In House DC18C6 Resin

- ~0.75 M DC18C6
- DCM solvent
- Free resin
- 2 mL pre-packed

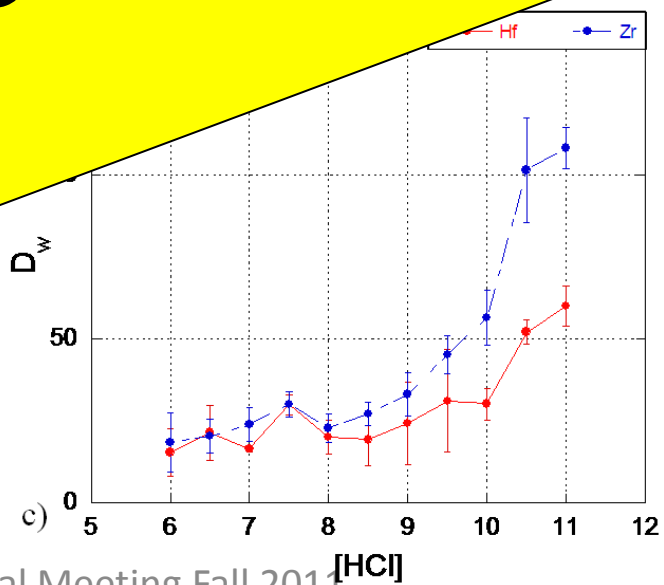
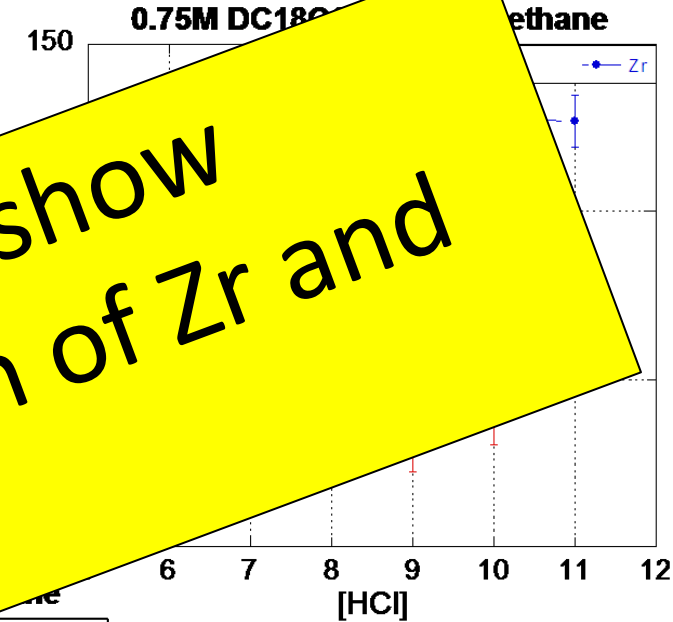
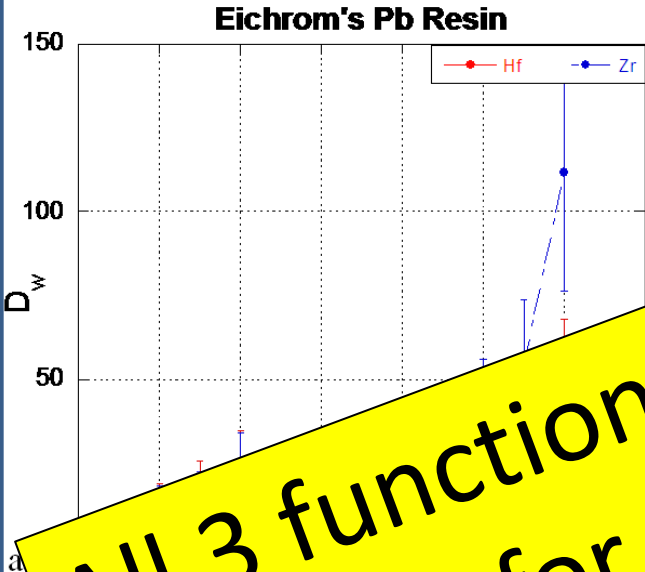


In House DB18C6 Resin

- ~0.75 M DB18C6
- DCM solvent
- Free resin
- 2 mL pre-packed

Batch Study Results

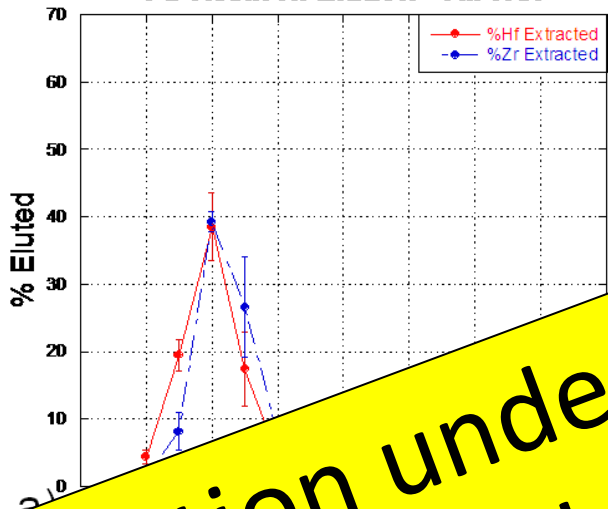
radiation chemistry



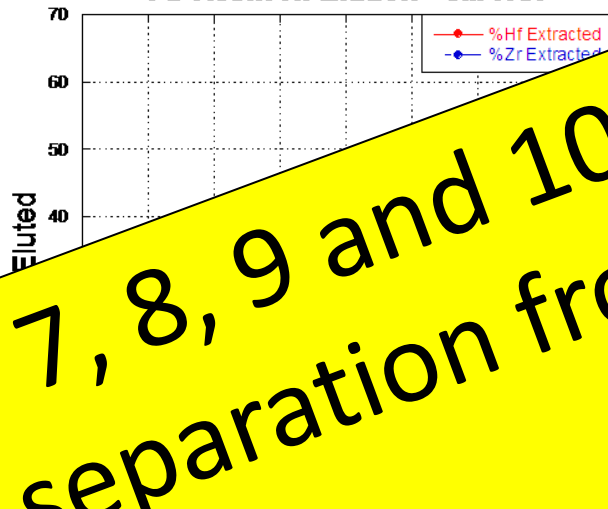
All 3 functional groups show promise for separation of Zr and Hf

Eichrom's Pb Resin

Pb Resin Hf Elution - 7M HCl

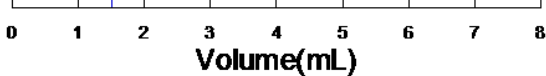


Pb Resin Hf Elution - 8M HCl



Hf elution under 7, 8, 9 and 10 M HCl shows little separation from Zr

c)

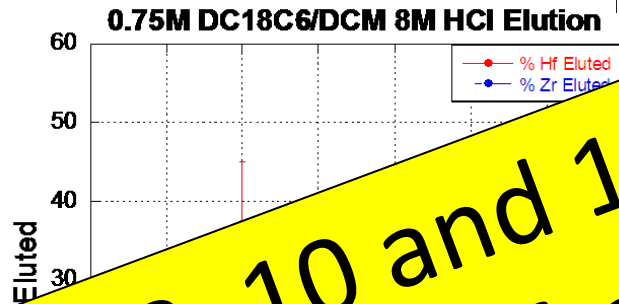
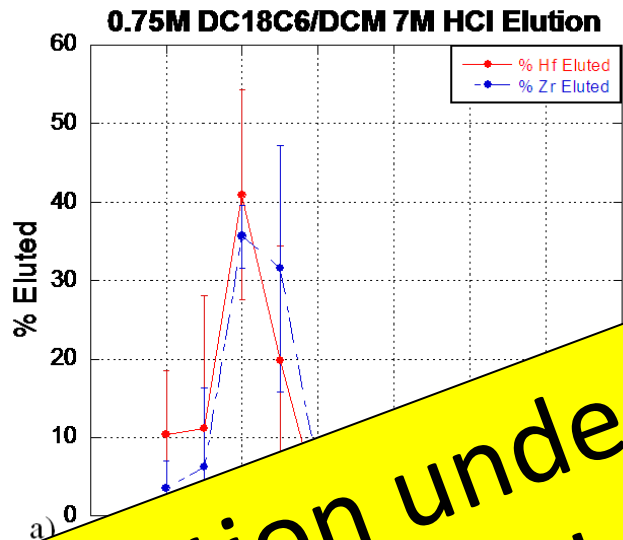


d)

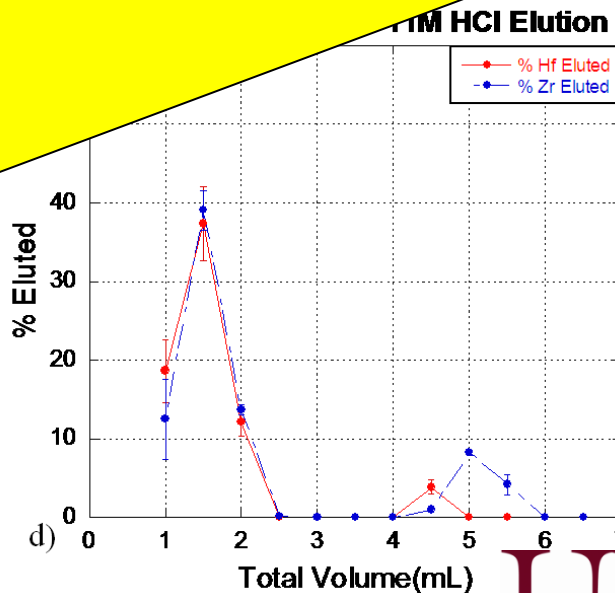
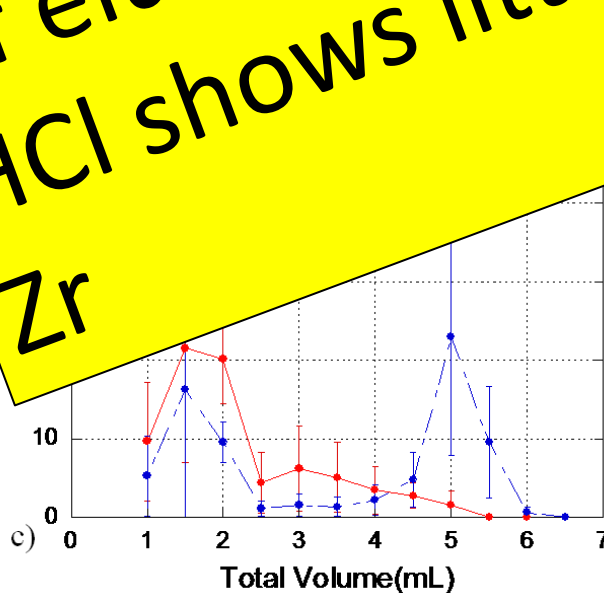


DC18C6 Resin

radi ochemistry



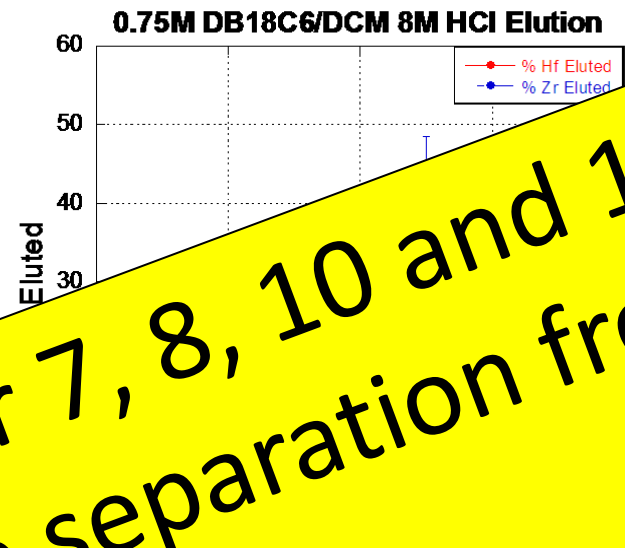
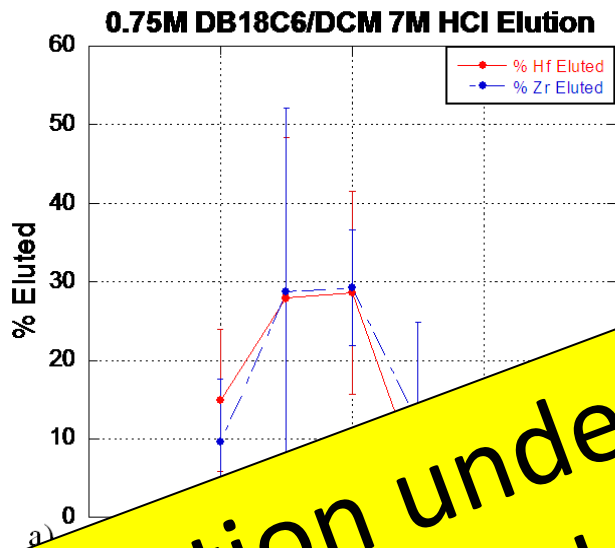
Hf elution under 7, 8, 10 and 11 M HCl shows little separation from Zr



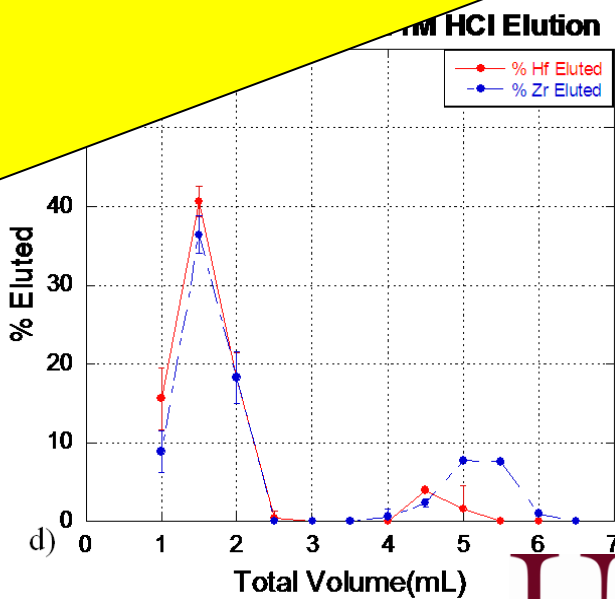
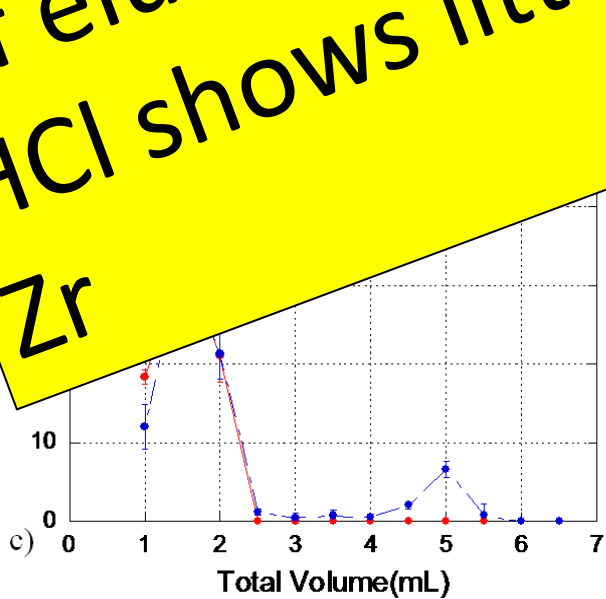
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Error bars are standard deviation of 3 trials

DB18C6 Resin



Hf elution under 7, 8, 10 and 11 M HCl shows little separation from Zr



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Error bars are standard deviation of 3 trials

radi ochemistry

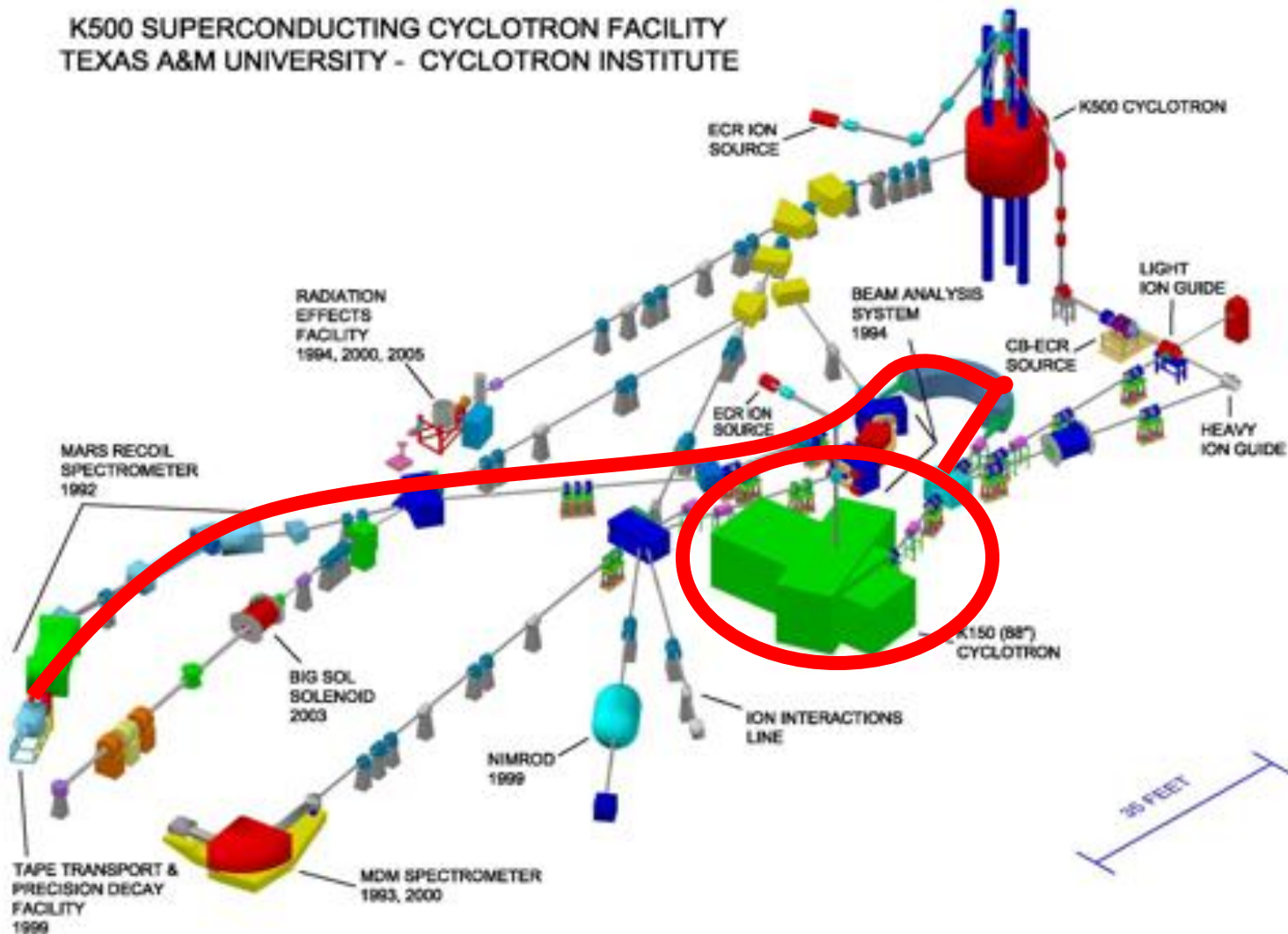
Conclusions

- Solvent has little effect on separation of Zr and Hf
- 0.75 M DtBC18C6, DC18C6 and DB18C6 show no promise for application to Rf chemistry
 - Most likely due to the crown's inability to form the needed sandwich structure on the resin

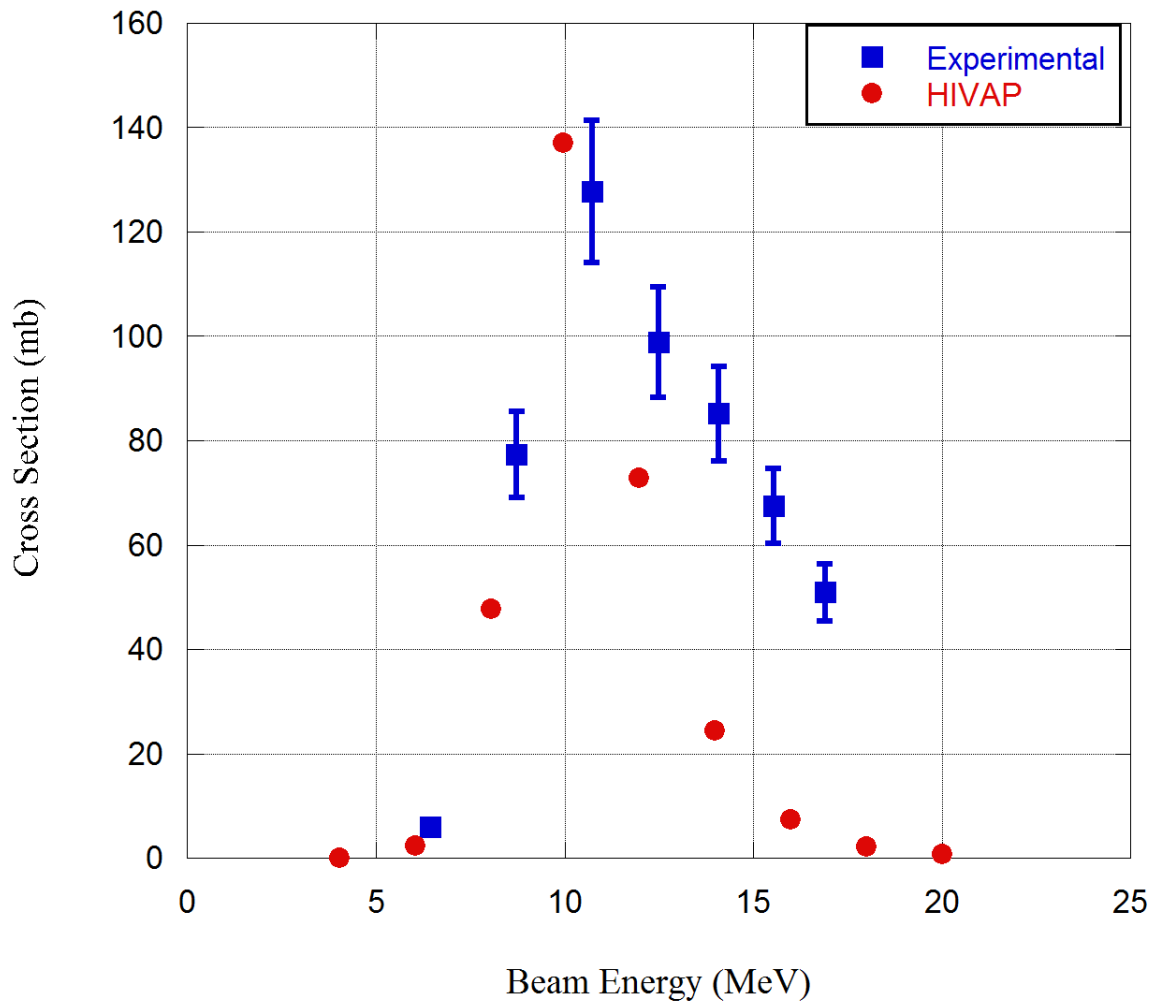
Future Directions

Why Texas A&M

K500 SUPERCONDUCTING CYCLOTRON FACILITY
TEXAS A&M UNIVERSITY - CYCLOTRON INSTITUTE

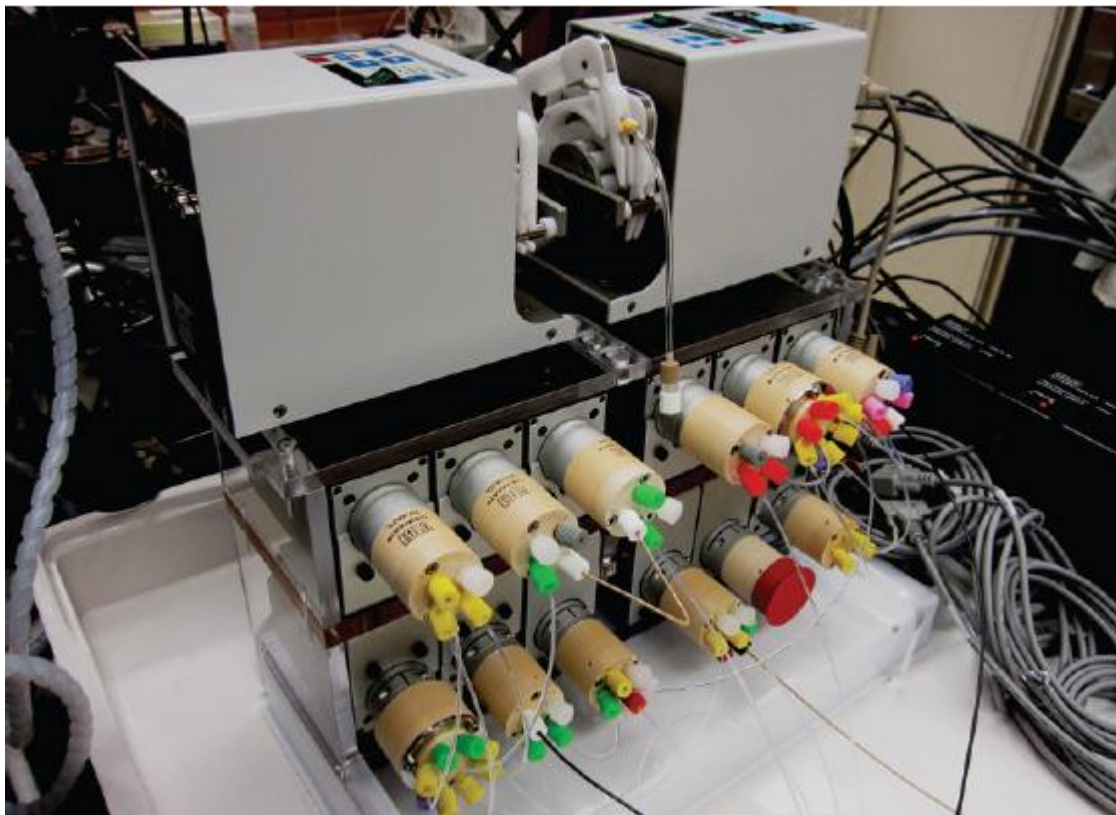


Large Scale Production of ^{175}Hf



Off-line to On-Line Chemistry

• If any of the extraction systems exhibit large separation factors of $^{95}\text{Zr}/^{175}\text{Hf}$ automated separations will be conducted with accelerator produced ^{85}Zr and ^{169}Hf



Acknowledgements



- UNLV Radiochemistry Group
 - Julie Bertoia
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 - George Kim
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