

MBASE- The Molecular Basis of Advanced Nuclear Fuel Separations



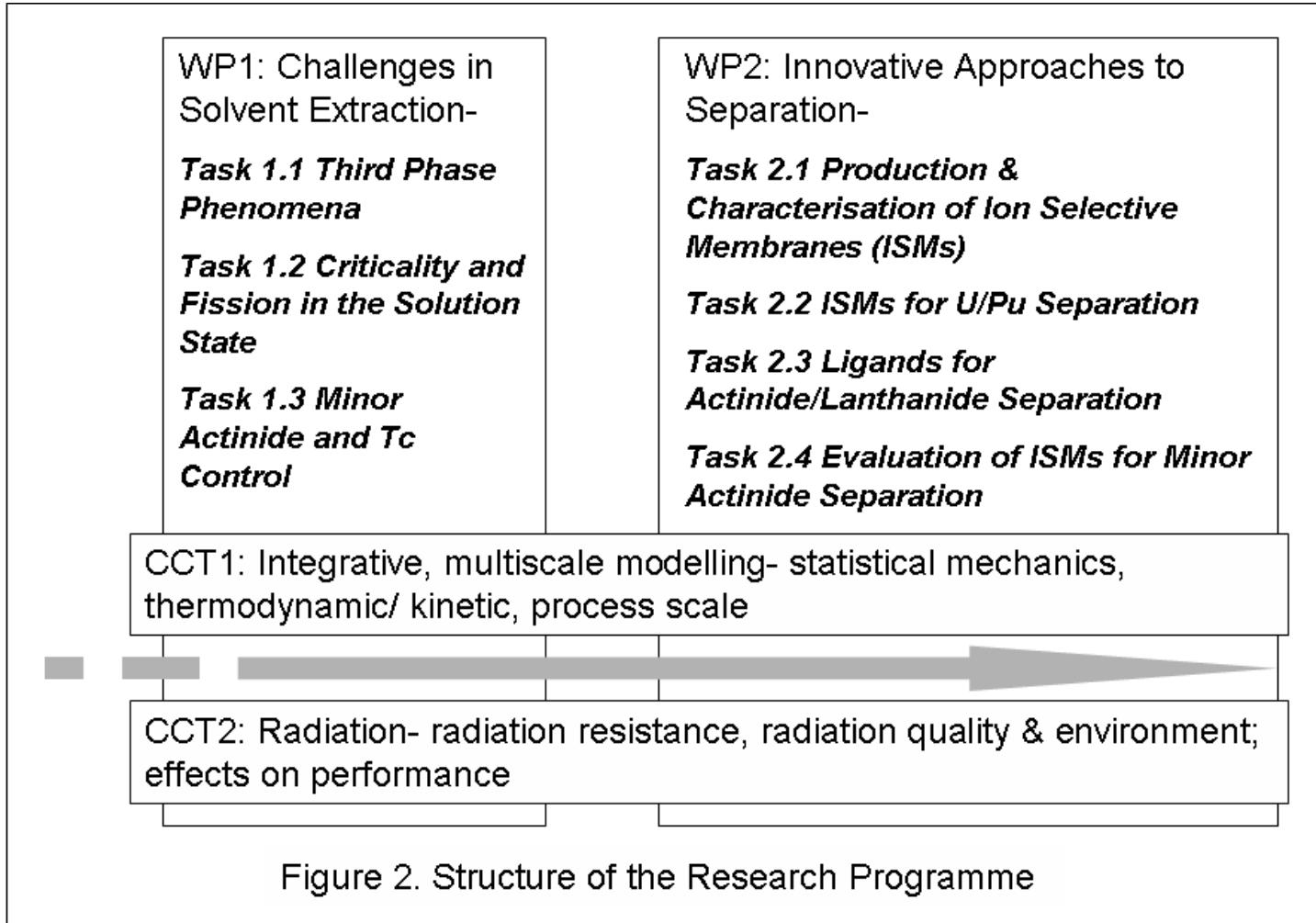
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Imperial College London
Lancaster University
National Nuclear Laboratory
Serco
University of Manchester
University of Reading

CEA
Idaho National Laboratory
Karlsruhe Institute of Technology
University of Notre Dame



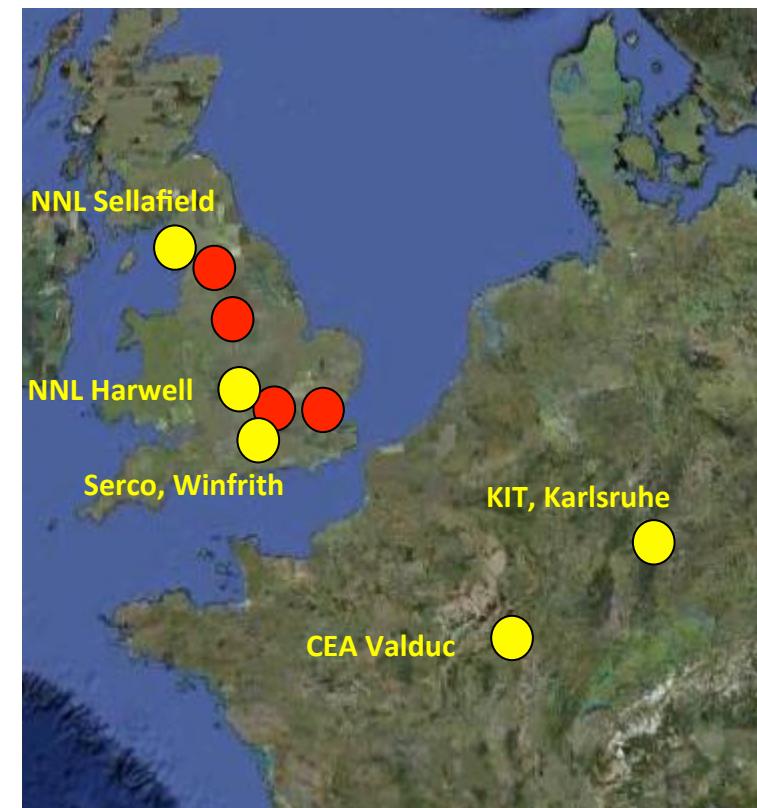
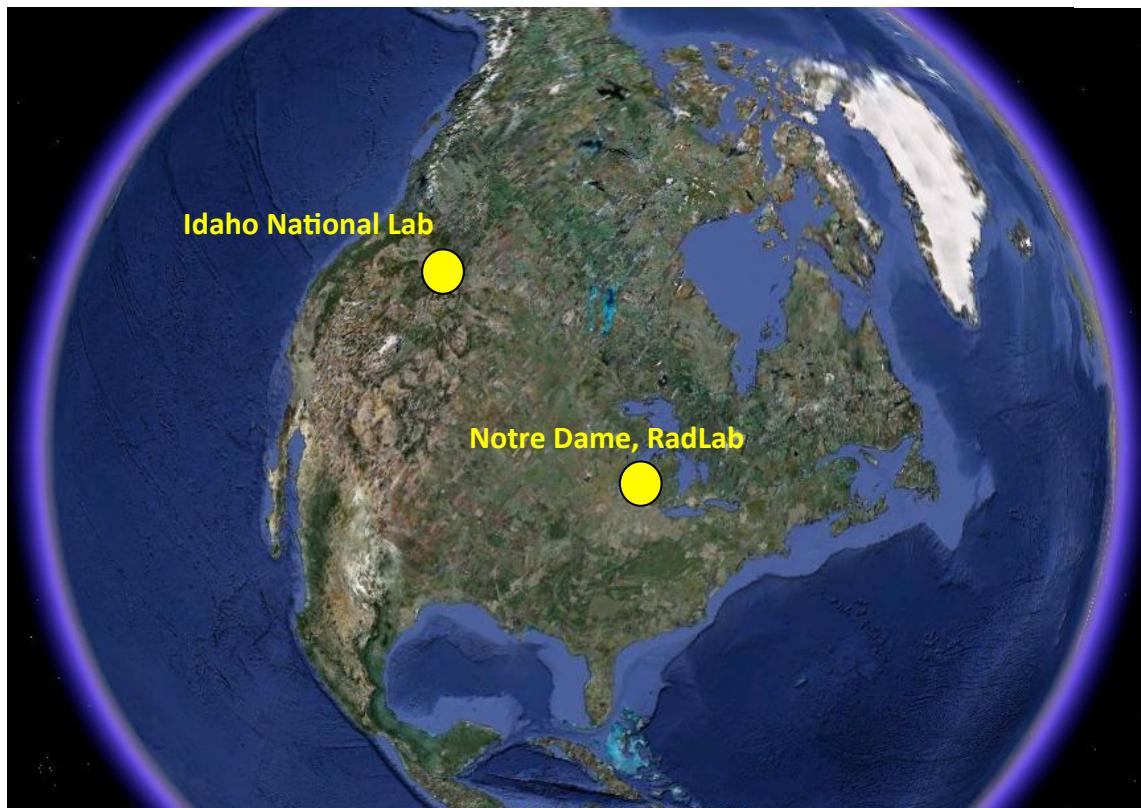
Structure of the Research Programme



Objectives

- To explore aspects of both established and innovative separation processes, linking them through the common theme of minor actinide separation
- To adopt an integrated approach, encompassing both physical and chemical phenomena
- To link both experimental and multiscale (molecular to process) modelling studies and
- To use molecular scale knowledge to improve separation performance in current or future processes
- Started 1 April 2010; End Date 30 Sept 2013

Collaborations

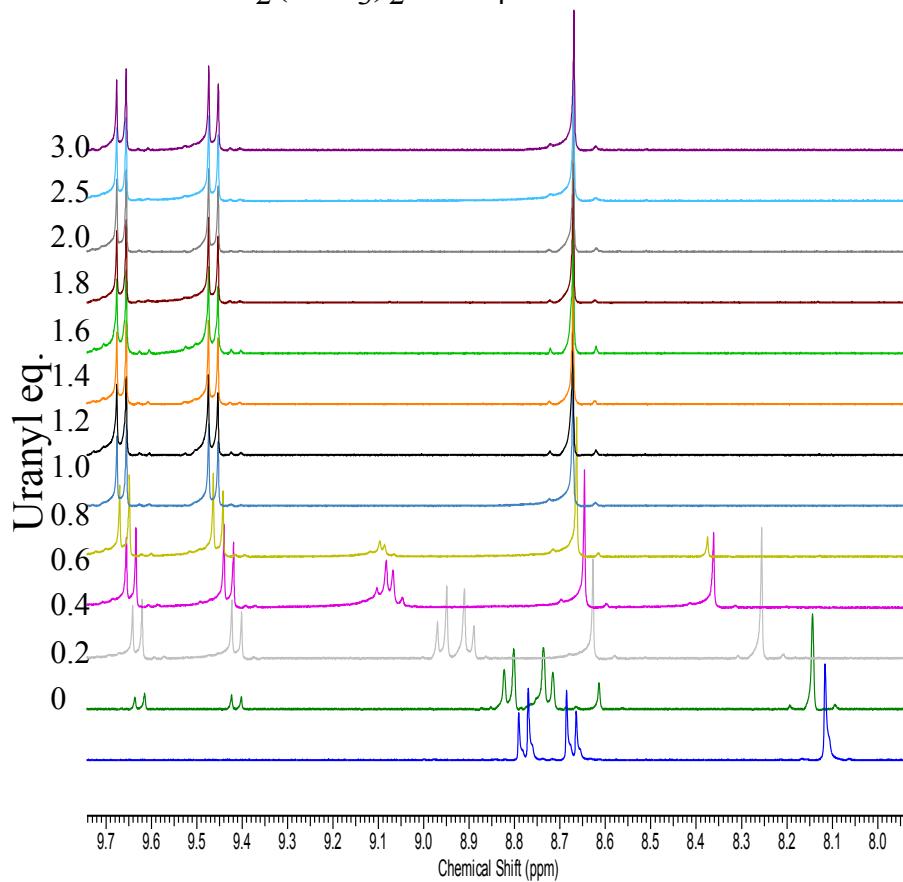


NNL Sellafield- flowsheet development; active separation facilities; *NNL Harwell*- radiation effects; *Serco, Winfrith*- criticality modelling; *CEA Valduc*- criticality data; *KIT, Karlsruhe*- transuranic synchrotron facility; *Notre Dame RadLab*- experimental radiation science facilities; *Idaho National Lab*- active laboratory facilities, minor actinide chemistry and spectroscopy, radiation effects

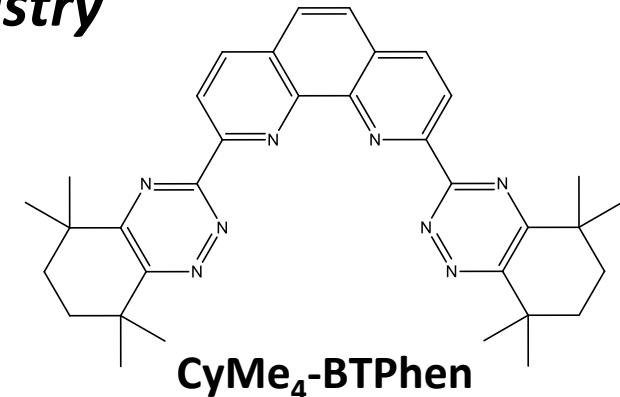
Actinide Extraction Chemistry

Solution Studies

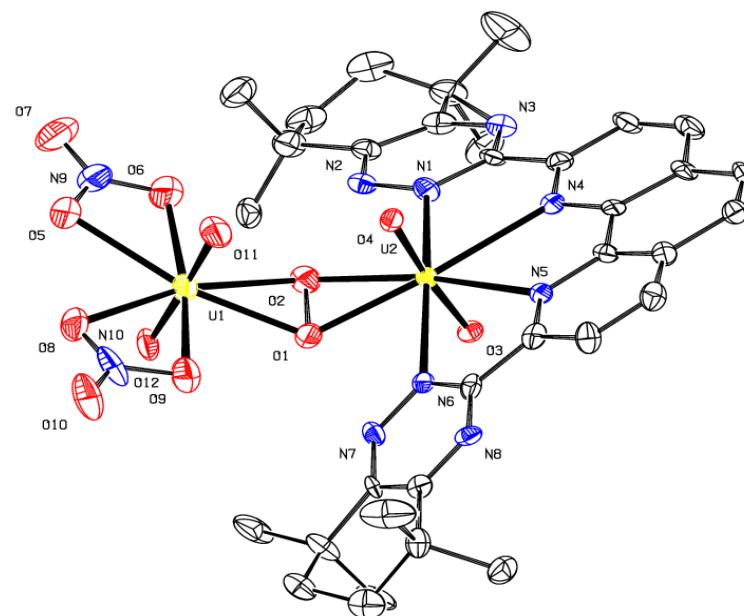
^1H NMR titration of CyMe₄-BTPhen with UO₂(NO₃)₂ in d₄-methanol



- 1:1 metal:ligand species in solution.



Structural Characterisation



- a bis(uranyl) species bridged by a peroxide unit

Critical Liquids

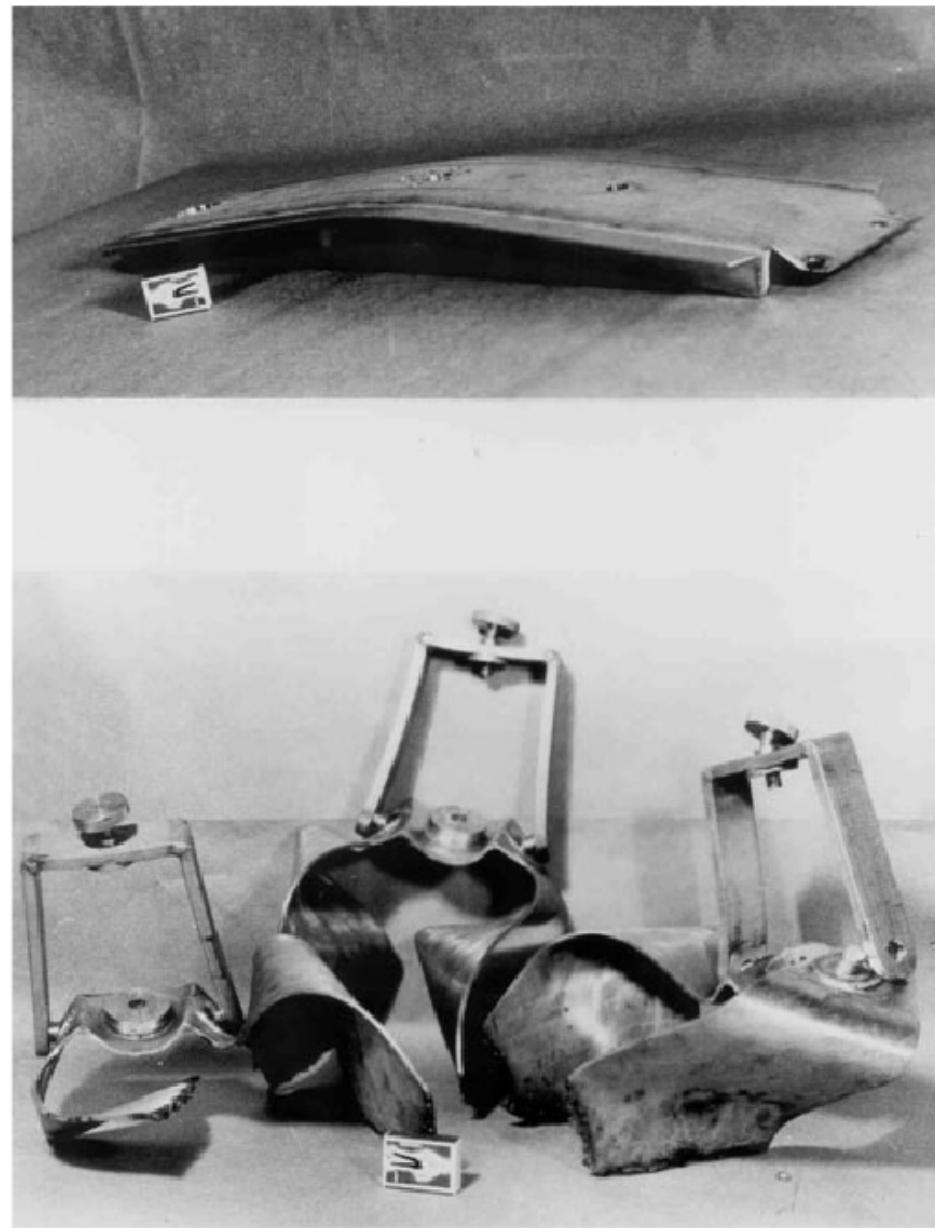
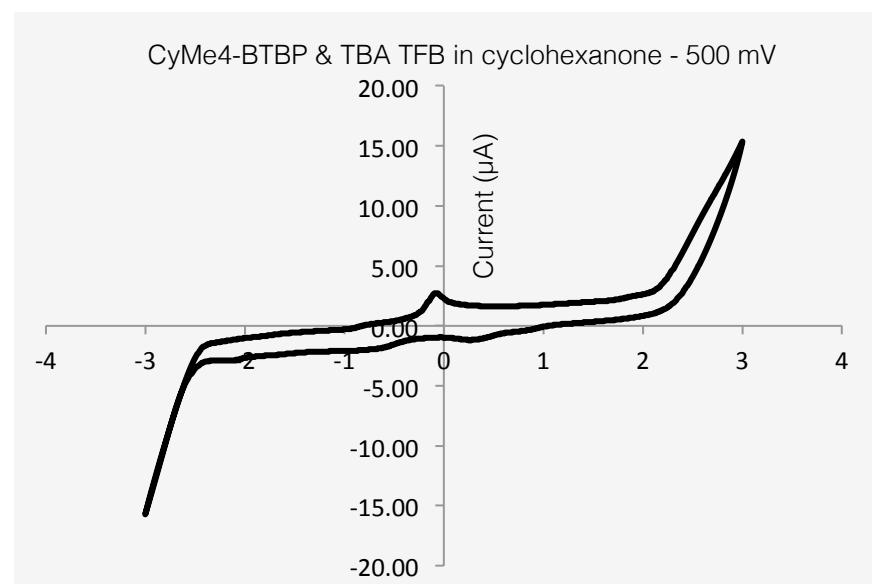
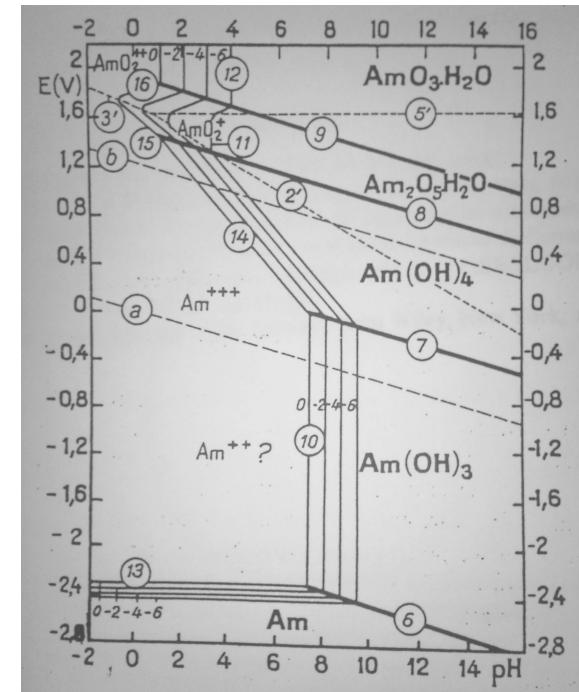
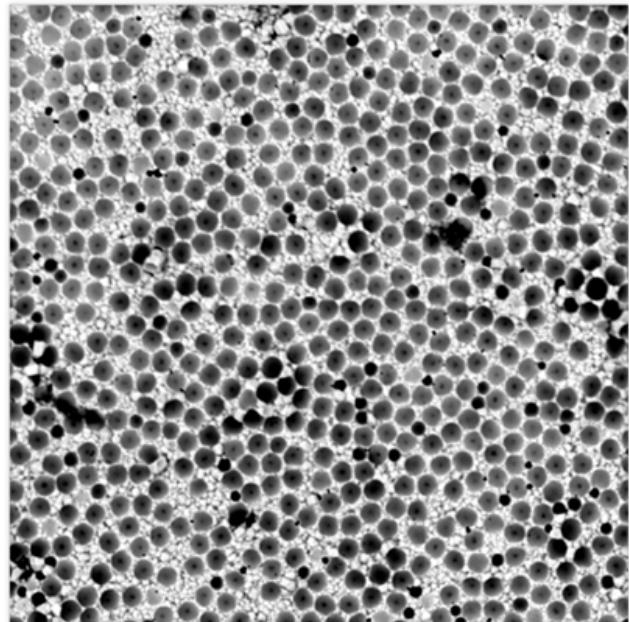
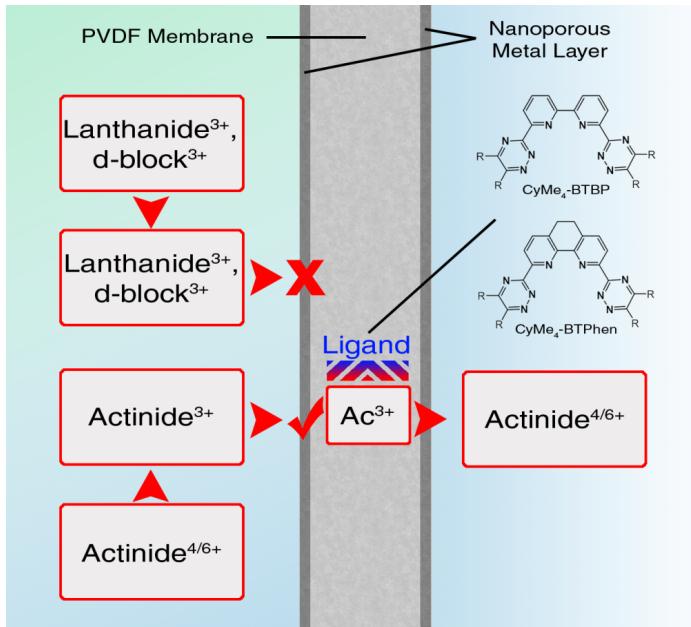
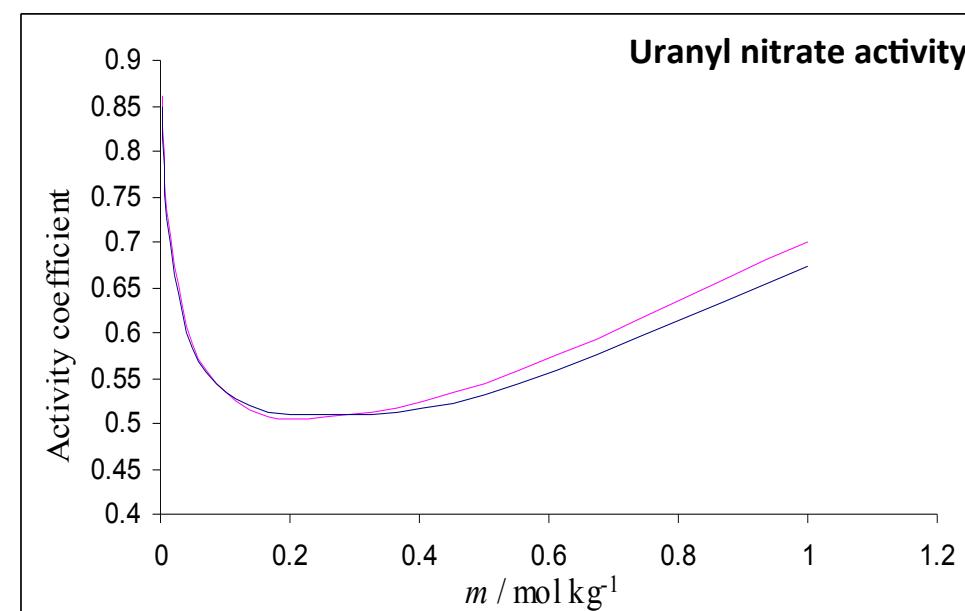
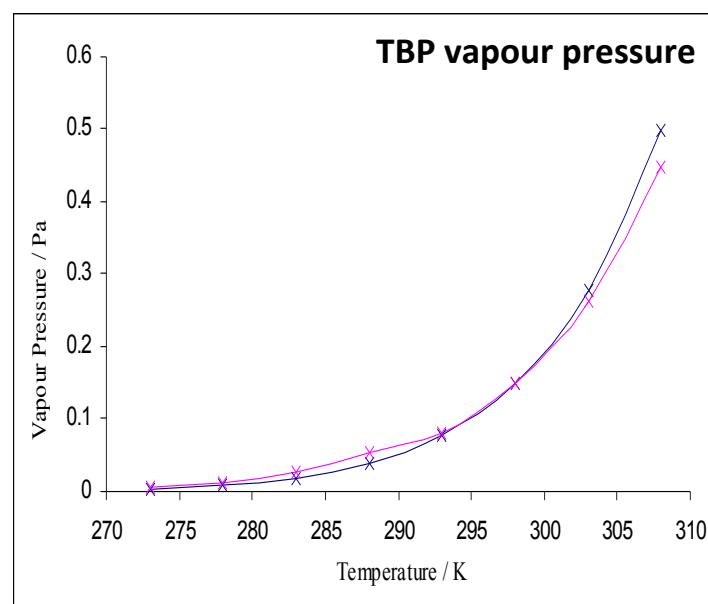
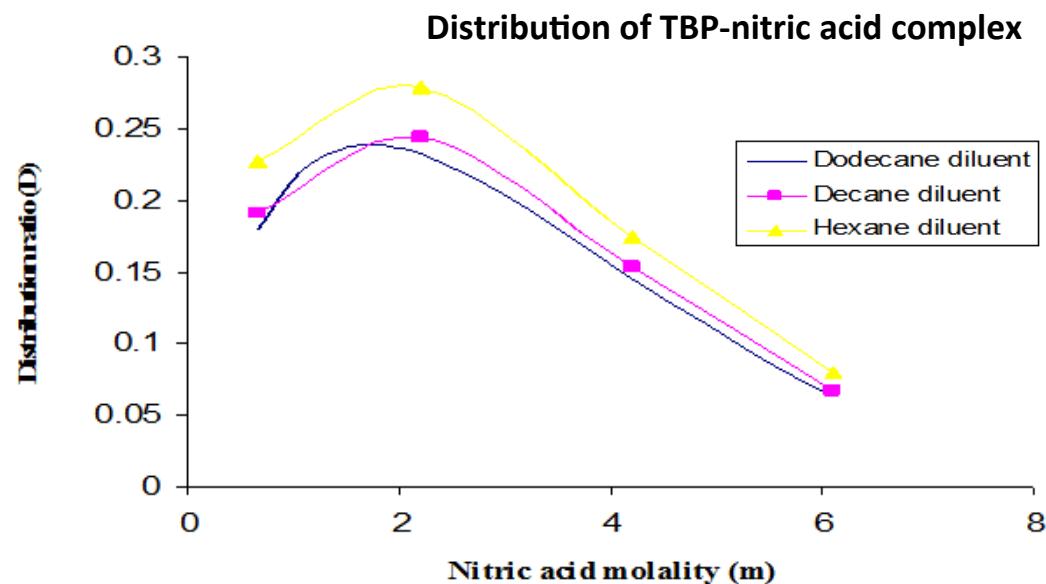
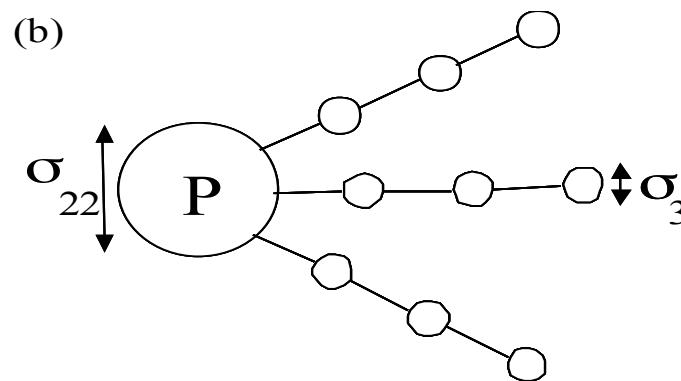


Fig. 14. Photograph of the test vessel supports after the CRAC 44 experiment.

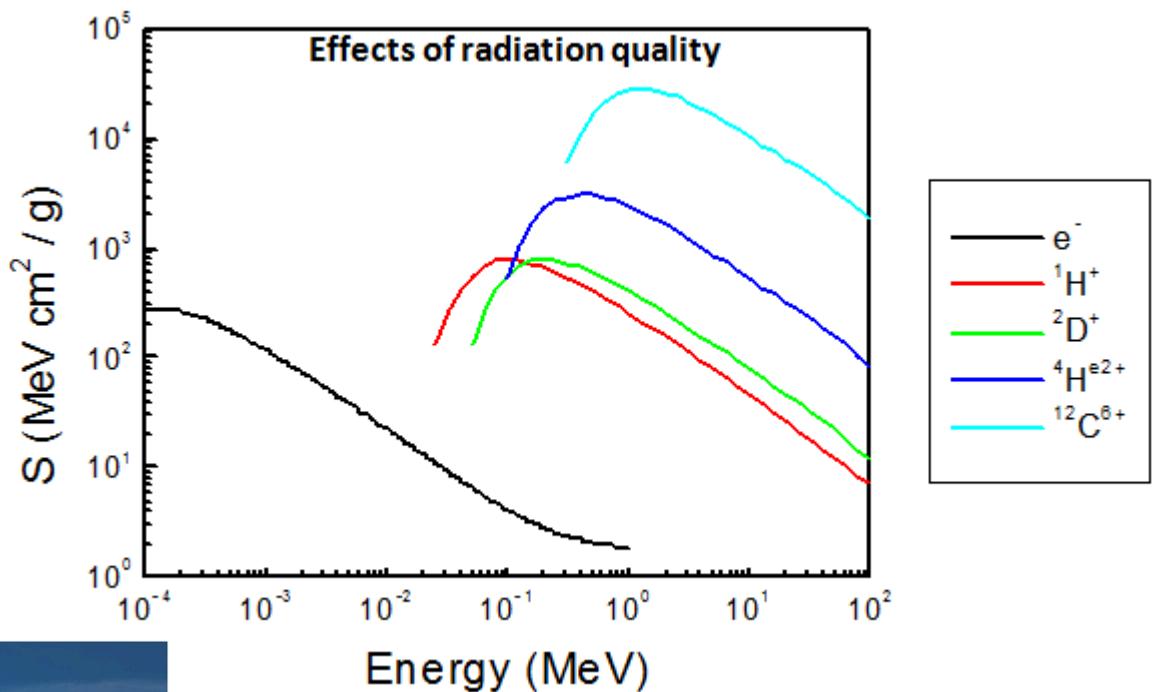
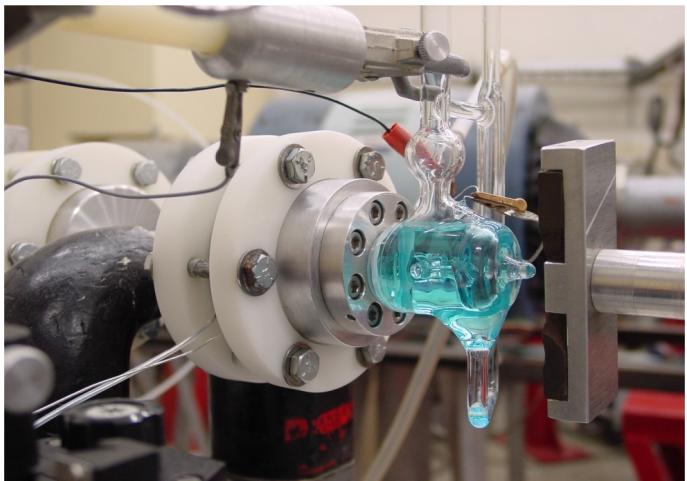
Membrane-Based Separation



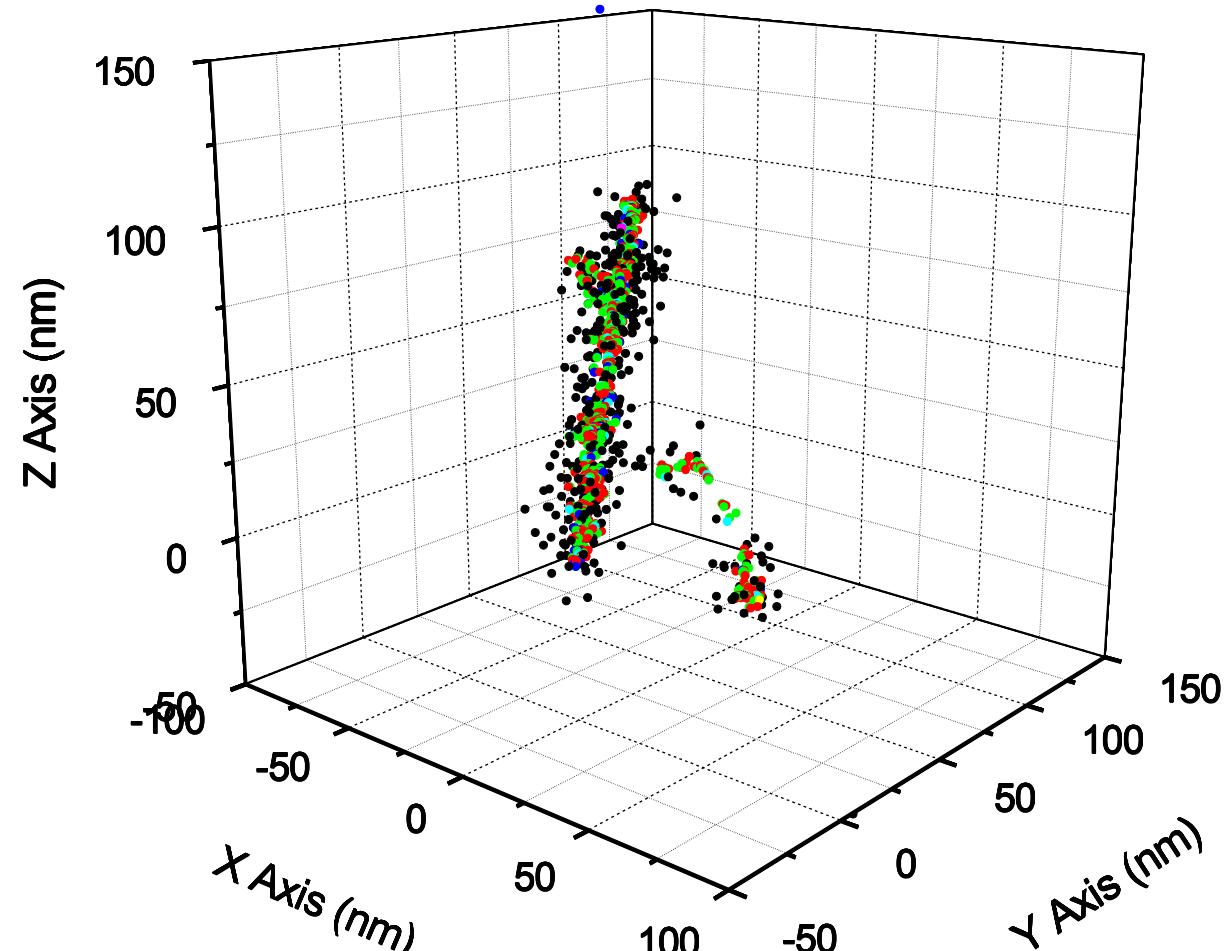
Statistical Associating Fluid Theory



Radiation Effects

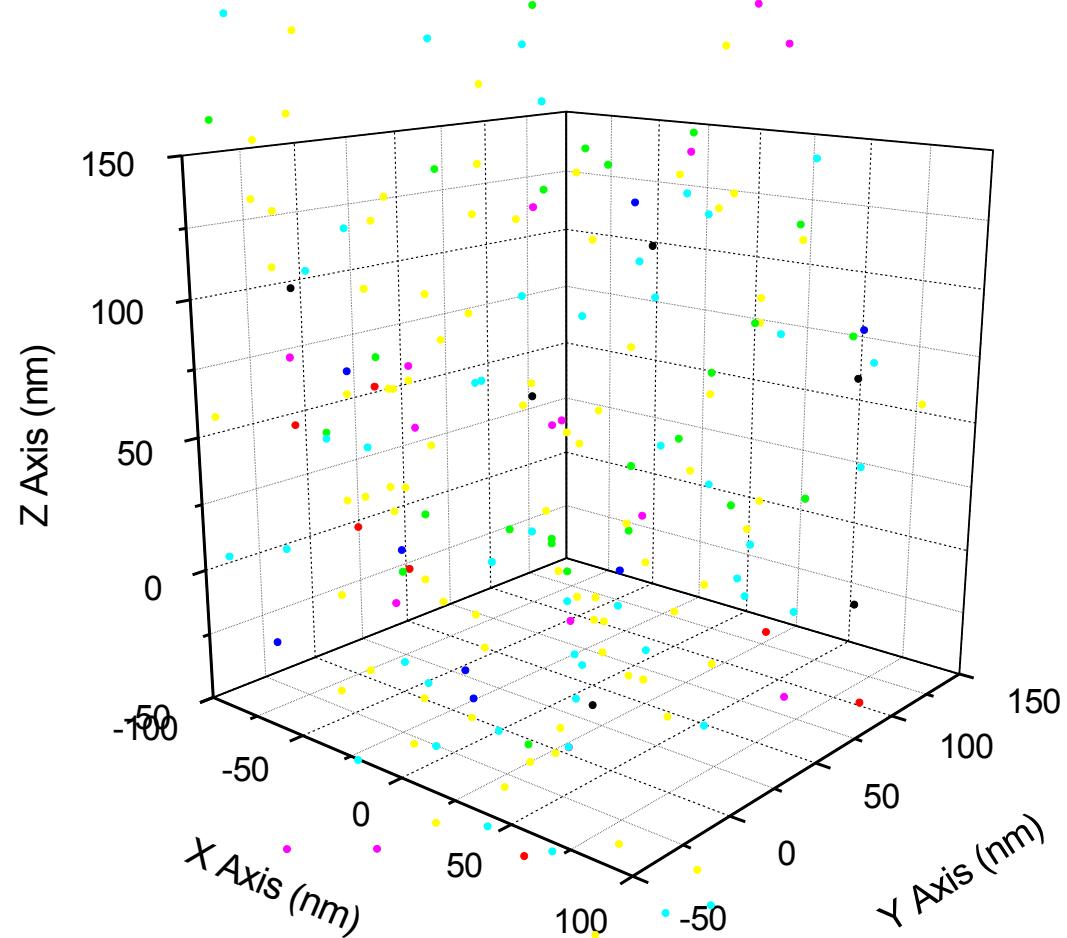


Development of a 10 keV section of a 5 MeV ${}^4\text{He}^{2+}$ ion track in water



S²⁰⁰ spectra tracks electrons

Development of a 10 keV section of a 5 MeV ${}^4\text{He}^{2+}$ ion track in water



1 μs

- Complete description of physical and chemical evolution of radiation track