

SLATT UNDERGRADUATE STUDENT FELLOWSHIP

CHECK ONE:

UPDATE



FINAL REPORT

SLATT SCHOLAR:	Anna Kluender
FACULTY ADVISOR:	Dr. Brandon Ashfeld
REPORT PERIOD:	5/21/2018 – 8/1/2018
PROJECT TITLE:	Understanding Lower Critical Solution Temperature Ionic Liquids in the Development of Revolutionary Absorptive Cooling Fluids
CONNECTION TO ND ENERGY'S RESEARCH AREAS (CHECK ALL THAT APPLY):	<input checked="" type="checkbox"/> Energy Conversion and Efficiency <input type="checkbox"/> Sustainable and Secure Nuclear <input type="checkbox"/> Smart Storage and Distribution <input type="checkbox"/> Transformation Solar <input type="checkbox"/> Sustainable Bio/Fossil Fuels <input type="checkbox"/> Transformative Wind

MAJOR GOALS AND ACCOMPLISHMENTS:

List your major research goals and provide a brief description of your accomplishments (1-2 sentences). Indicate the percentage completed for each goal. Please use a separate sheet to share additional details, technical results, charts, and graphics.

MAJOR RESEARCH GOALS	ACTUAL PERFORMANCE AND ACCOMPLISHMENTS	% OF GOAL COMPLETED
Synthesis of known ILs	I was able to successfully synthesize 16 ILs with 4 more coming soon due to the acquisition of a necessary compound.	85%
Purification of synthesized ILs	All ILs synthesized have been screened via mass spectrometry for ion purity. Most have not yet been completely dried to remove residual water content.	60%
Explore amino acid substrates for ILs	I was able to subject ### amio acids to the modifications to make them suitable for IL preparation.	100%
Understand LCST phenomena	Compounds have not yet been sent off for further testing due to goal #2. Hopefully will be achieved by mid-semester.	0%
Synthesis of new/unknown ILs	Successfully synthesized small quantities of experimental ILs. ILs proposed based on possible LCST behavior are to be accessed during academic semester.	15%

RESEARCH OUTPUT:

Please provide detailed information below regarding any output resulting from your research project. Please check with your faculty advisor if you are unsure how to respond.

CATEGORY	INFORMATION
EXTERNAL PROPOSALS	N/A
EXTERNAL AWARDS	N/A
JOURNAL ARTICLES	N/A
BOOKS AND CHAPTERS	N/A
PUBLIC PRESENTATIONS, SEMINARS, LECTURES	Poster Presentation at Summer Undergraduate Research Symposium at Notre Dame
AWARDS, PRIZES, RECOGNITIONS	N/A
INTERNAL COLLABORATIONS FOSTERED	N/A
EXTERNAL COLLABORATIONS FOSTERED	N/A
WEBSITE(S) FEATURING RESEARCH PROJECT	N/A
OTHER PRODUCTS AND SERVICES (e.g., media reports, databases, software, models, curricula, instruments, education programs, outreach for ND Energy and other groups)	(Please describe each item in detail) ????

RESEARCH EXPERIENCE:

Please let us know what you thought of your research experience: Did this experience meet your expectations? Was there something else that could have been done to improve your research experience? Were lab personnel helpful and responsive to your needs? What could have been done differently, if anything, to achieve additional research results?

I really enjoyed my summer research experience. I feel that I left this summer having learned a lot, both from the chemistry I accomplished as well as the people I worked with. My fellow researchers were great and truly encouraged, helped, and supported me in my endeavors. Dr. Ashfeld was equally supportive and made sure myself the other undergrad in my lab profited from our summer. Even in times of accidents or mistakes, I felt that my fellow lab members were keen to make the moment a learning experience rather than a time of blame. I also enjoyed the other resources I was able to take advantage of while on Notre Dame's campus this summer, namely the access to other undergraduate researchers as well as volunteering opportunities like the Robinson Center Outreach. Overall, I got so much more out of this summer than I ever anticipated, and I know

MAJOR GOALS AND ACCOMPLISHMENTS (Additional Details, Technical Results, Charts and Graphics)

As mentioned above, over the course of the summer I was able to synthesize over a dozen ionic liquids. Reaction schemes and molecular structures for a portion of the synthesized ILs are shown at below and at right in Fig. 1, 2, & 3. Most ILs were synthesized on a several-gram scale. Amino acid substrates were investigated on a 200 mg scale.

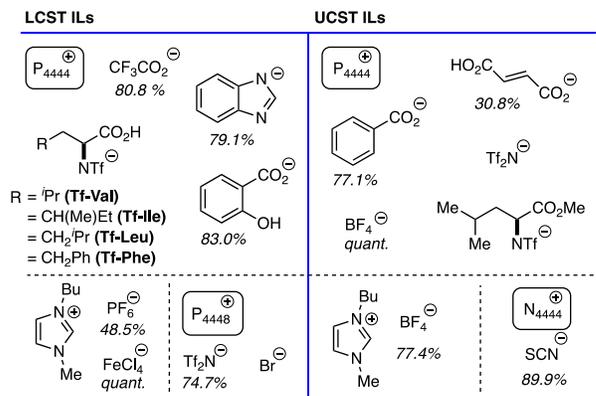


Fig. 1, Chart of synthesized ILs & separation behavior

Triflate-Protected Amino Acid ILs

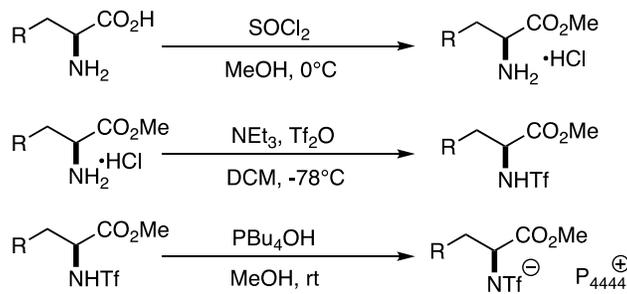


Fig. 2, Reaction schemes for amino acid-based ILs

Tetra-*n*-butylphosphonium- and Bmim-based ILs

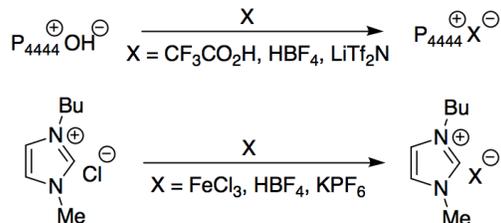


Fig. 3, Reaction scheme for PBU₄⁺- and Bmim-based ILs

By using mass spectrometry, I was able to verify the purity of the ILs I synthesized. Below, in Fig. 4, are the positive and negative ion scans of one of the ILs I synthesized, NAME. The lack of peaks in the spectra indicates that the only ions present are the components of the IL, meaning the sample is free of ionic impurities.

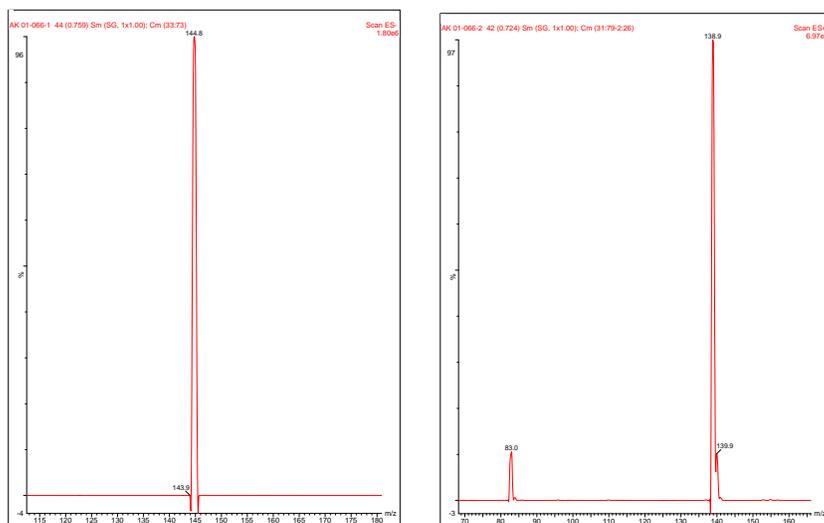


Fig. 4, Negative and positive, respectively, ion scans for NAME.