

# **Ionic Liquids: Alternative Solvents for Catalysis and Separations**

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**Maritimes Centre for Green Chemistry**



**One University. One World. Yours.**

# Outline

- The chemistry
- The Role of SMU-ILO / TTO
- The Role of GCC
- Where to now?

# Green Chemistry

- the utilization of set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products.

*Green Chemistry – Theory and Practice*, P. T. Anastas & J. C. Warner, Oxford, 1998

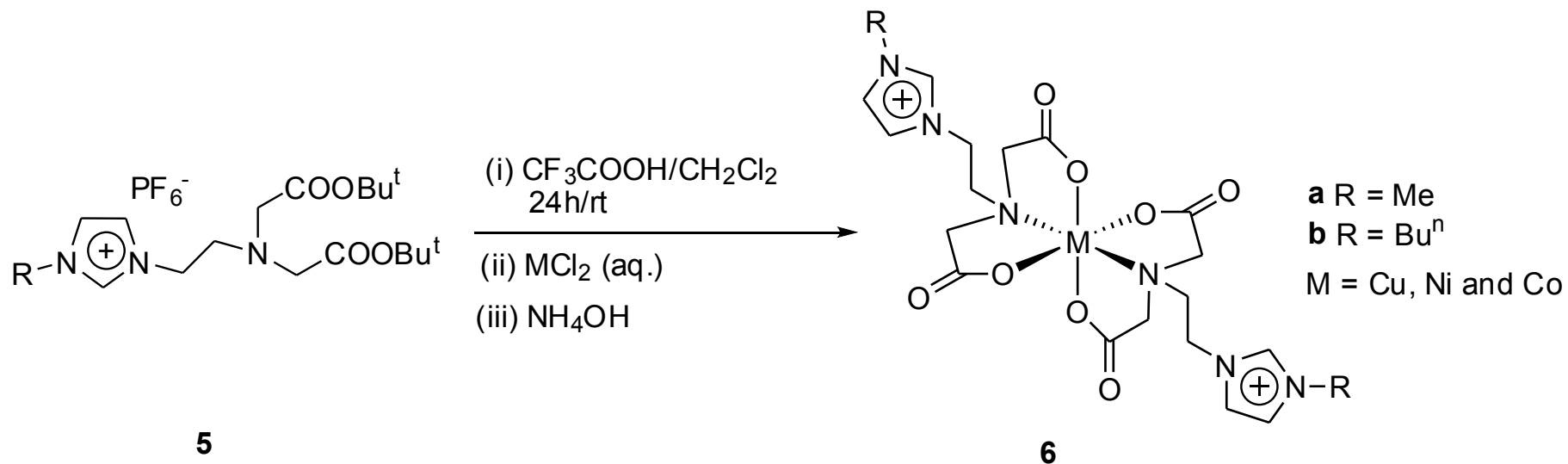
# Green Chemistry

## 12 Principles of *Green Chemistry*

- (1) Prevent Waste
- (2) Atom Economy
- (3) Less Hazardous Chemical Synthesis
- (4) Designing Safer Chemicals
- (5) Safer Solvents and Auxiliaries
- (6) Design for Energy Efficiency
- (7) Use of Renewable Feedstocks
- (8) Reduce Derivatives
- (9) Catalysis
- (10) Design for Degradation
- (11) Real-time Analysis for Pollution Prevention
- (12) Inherently Safer Chemistry for Accident Prevention

# Chelating TSILs

## 1st Generation - Separations

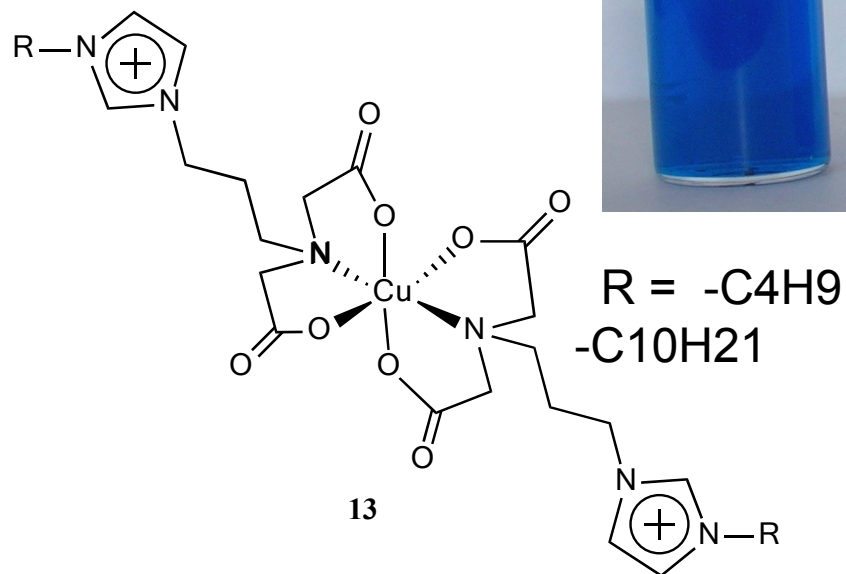
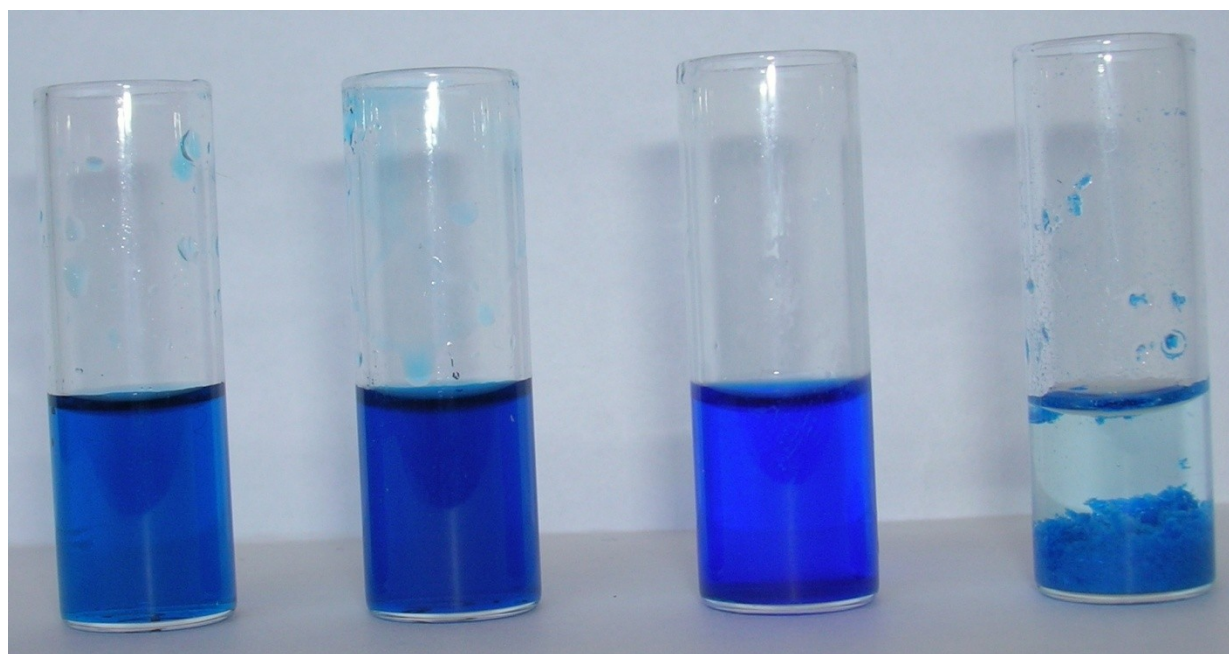


(a) *US Provisional Patent Application Number 60/752,880 2005.*

(b) *Dalton Trans. 2008*, 4595 – 4601.

(c) *Inorg. Chem. 2006*; 45(25); 10025-10027.

# Water solubility of Cu[PDACnim]2



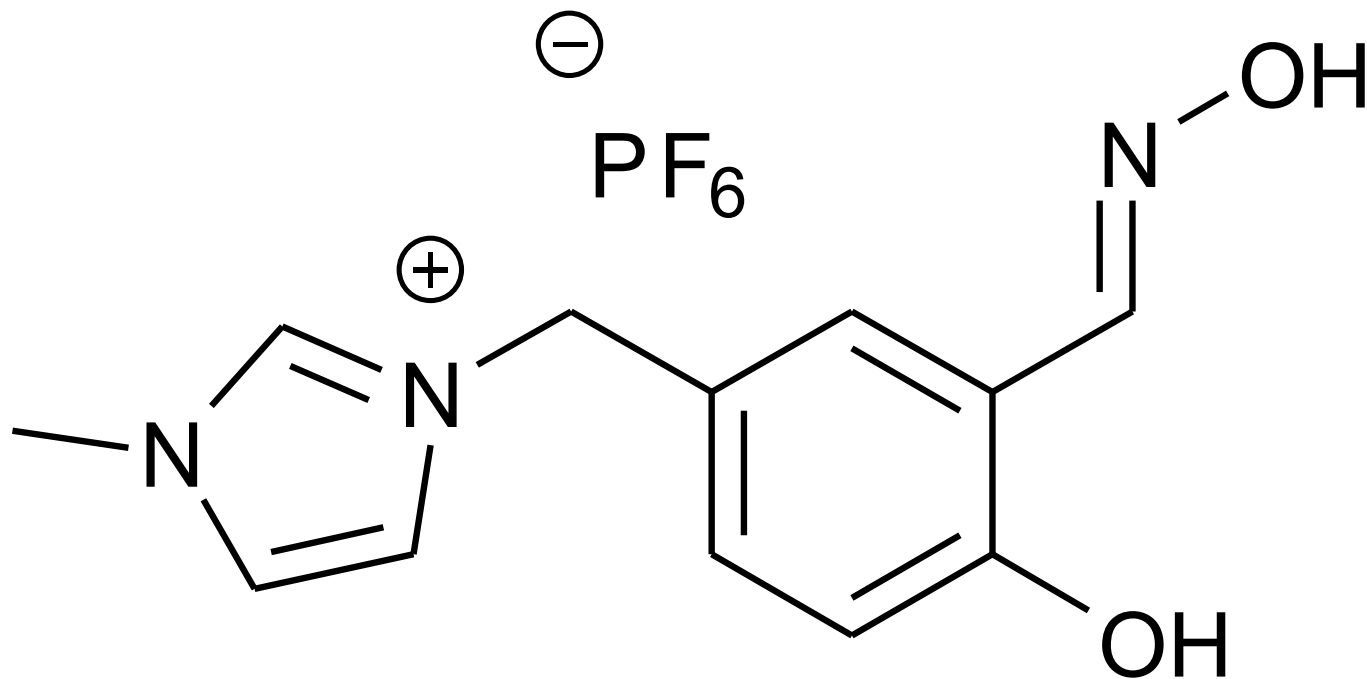
Ratio of concentrations of Cu(II) in sample solution to the control solution using 1st

Gen.

Copper complex derived from	C <sub>n</sub>	<i>K<sub>n</sub></i> ([Cu <sup>2+</sup> ] / [Cu <sup>2+</sup> ] <sub>o</sub> )
13a	C4	0.986
13b	C6	0.652
13c	C8	0.194
13d	C10	0.071

# Chelating TSILs

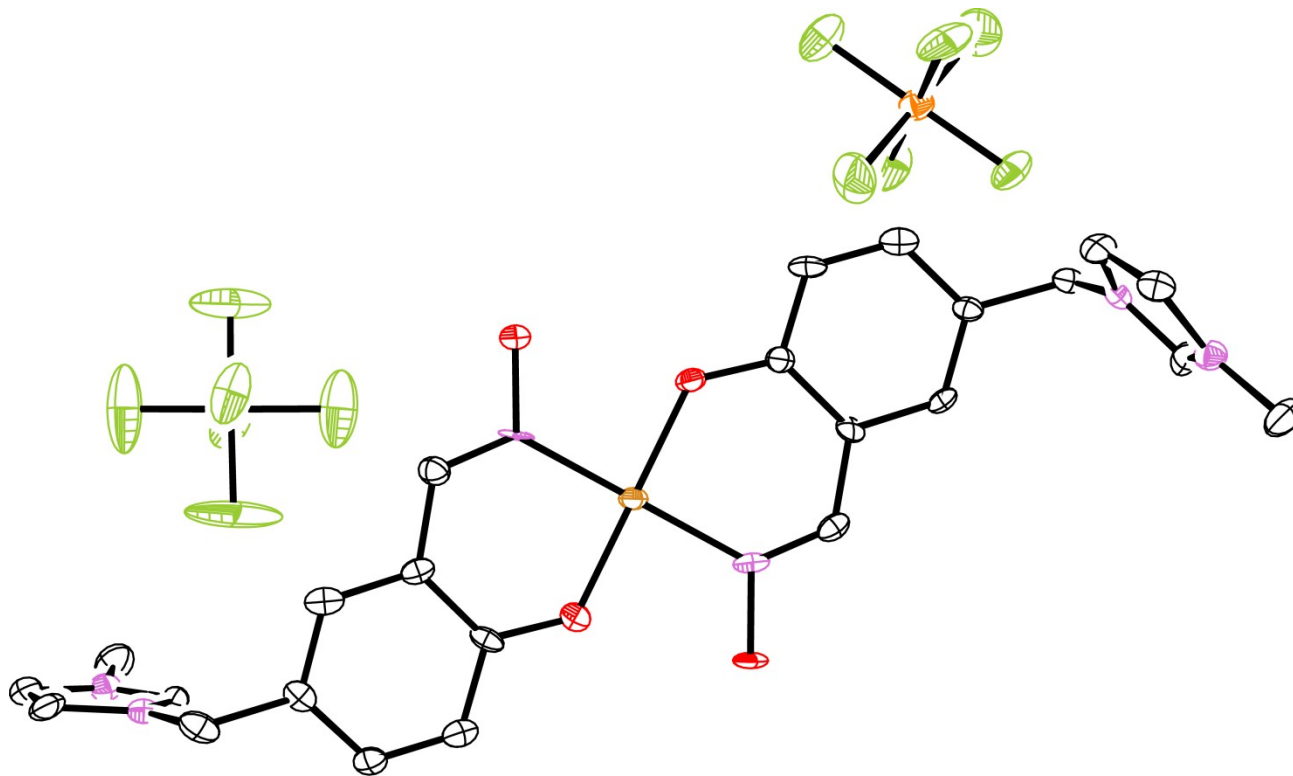
## *2nd Generation -Separations*

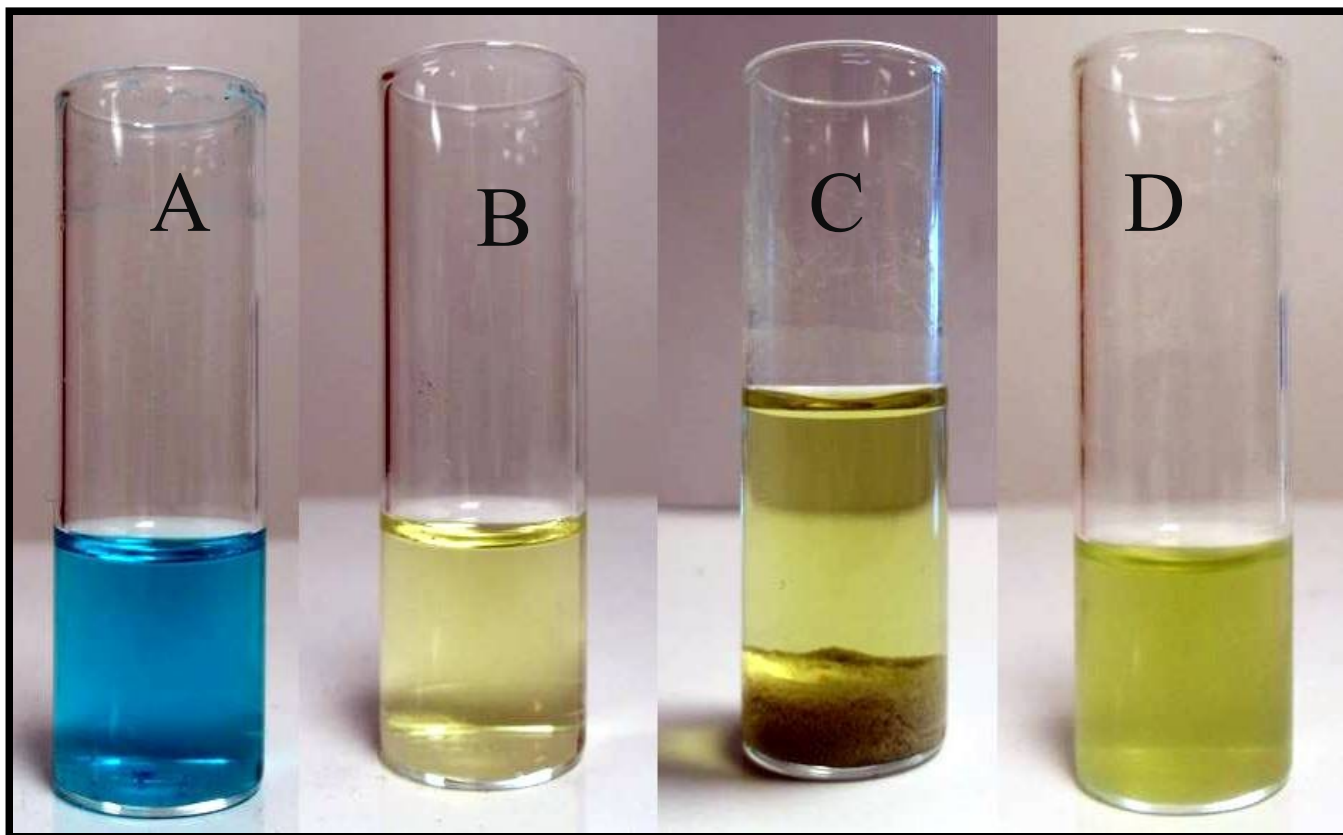


- Robert D. Singer and Prashant Upendra Naik U.S. Pat. Appl. Publ. (2010) US 20100324273 A1 20101223
- Prashant Naik and Robert D. Singer PCT Int. Appl. , PCT/CA2009/000229; **WO 2009/105881**.
- Prashant Naik and Robert D. Singer Provisional Patent filed in US Patent and Trademark Office (USPTO), Appl.#: **61/032,103**.
- Prashant U. Naik, Greg McManus, Michael J. Zaworotko and Robert D. Singer\* *Dalton Trans.* **2008**, 4834 – 4836.



# Bis(IL-oxime)-Cu(II), 17.





# Ratio of concentrations of Cu(II) in sample solution to the control solution using 2nd Gen.

<b>Copper complex derived from</b>	<i>Kn (lab)</i> ([Cu <sup>2+</sup> ] / [Cu <sup>2+</sup> ] <sub>o</sub> )	<i>Kn (real)</i> ([Cu <sup>2+</sup> ] / [Cu <sup>2+</sup> ] <sub>o</sub> )
<b>20a</b>	<b>0.011</b>	<b>0.757</b>
<b>20b</b>	<b>0.002</b>	<b>0.118</b>

# Partnership Benefits

## Paper strategy

Assess Technology  
Performance testing  
Apply for US provisional  
Access additional funding  
Seek Industry partner  
License Technology  
Scale up demonstration etc.

## Saint Mary's TTO

Springboard POC/PL fund  
Industrial/NSERC Fund  
Industry engagement

## Green Center Canada

Pre-screen  
POP  
Industry Input/detailed report  
Intermediary  
Intermediary/Industry Partner

# A model that works!

Our Process - Windows Internet Explorer

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Our Process

Once a technology is accepted, GreenCentre will formally secure commercialization rights by obtaining an exclusive, worldwide license from the technology's host institution.

### Technology Disclosure Timeline

Disclosure

Pre-Screen

GreenCentre secures a 90-day option

Full detailed technology assessment

Technology screening committee consulted to get relevant industry input

GreenCentre recommends one of three options

1) Technology returned with detailed report to the university and inventor(s)

2) Proof of Principle funding offered for further research

3) GreenCentre exclusively in-licenses technology

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# Leveraged funding

- **\$ 25 000** 2010 Green Centre Canada – Chelating Ionic Liquids
- **\$ 10 000** Springboard Atlantic – Patent and Legal Fund
- **\$ 20 000** NS-OED / Innovacorp - Early Commercialization Fund – postdoc funding
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# Acknowledgements

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- ☉ Saint Mary's University
- ☉ Pfizer Global R & D



**NSERC**  
**CRSNG**

LIGNOWORKS

Springboard







Thank you



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