Imidazolium Magnetic Ionic Liquid Solubilities in Water

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Outline

• Introduction to MILs
• Application of MILs
• Basics of Water Solubility
• Water Solubility Measurement
• Data and Results
Introduction to Ionic Liquids

• Room temperature salts
• Properties:
  - negligible vapor pressure
  - high thermal and chemical stability
  - tunable by selection of cation or anion
• Uses:
  - reaction solvent and catalyst
  - separation agent, water treatment
Magnetic Ionic Liquids (MILs)

- IL with metal ion incorporated into structure
- Liquids become paramagnetic
- First reported by Hayashi et al. in 2004

MILs in Separations

Ionic Liquid Water Solubility

- Break attractions $\rightarrow$ form cavity $\rightarrow$ insert solute into cavity
- $\Delta G = RT \ln(x\gamma)$
- $\gamma = f(\text{size, shape, polarity})$
- At equilibrium, $\Delta G = 0$
- $\log(C^*) = a(V_{ix}) + b$

Rmim[FeCl₄] Synthesis

• Equimolar amount of Rmim[Cl] and FeCl₃*6H₂O
• Stirred at room temperature until two phase mixture fully develops
• Organic phase separated and purified
Shake Flask Method

• 1 mL of water, 1 mL of MIL
• Shake vigorously for 2 min
• Equilibrate for 24 h using mechanical shaker at 100 rpm
• Centrifuge for 2 min at 500 rpm to induce phase separation
• Remove aliquot of water for testing
Rmim[FeCl₄]
Linear Free Energy Relationship

Averaged C*: 1.52 M
Micelle Formation

- Micellar behavior for [C(n)mim][FeCl₄], n > 6
- Brown et al. reported a CMC of 40.6 mmol/L for [C(10)mim][FeCl₄]
CMC Measurement via Tensiometer
Next Steps

• Synthesize MILs with other metals (Mn)
• Synthesize and test more water-immiscible MILs
• Test extraction efficiency of organic compounds under influence of magnetic field
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Bibliography


### Results Comparison

<table>
<thead>
<tr>
<th>MIL</th>
<th>Ciw (M) TOC</th>
<th>Ciw (M) TN</th>
<th>Ciw (M) UV-Vis</th>
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</thead>
<tbody>
<tr>
<td>C(2)mim[FeCl&lt;sub&gt;4&lt;/sub&gt;]</td>
<td>1.52 ± 0.02</td>
<td>1.65 ± 0.04</td>
<td>1.40 ± 0.01</td>
</tr>
<tr>
<td>C(4)mim[FeCl&lt;sub&gt;4&lt;/sub&gt;]</td>
<td>1.08 ± 0.04</td>
<td>1.19 ± 0.03</td>
<td>1.10 ± 0.03</td>
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<tr>
<td>C(6)mim[FeCl&lt;sub&gt;4&lt;/sub&gt;]</td>
<td>0.89 ± 0.03</td>
<td>0.93 ± 0.04</td>
<td>0.91 ± 0.04</td>
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<tr>
<td>C(8)mim[FeCl&lt;sub&gt;4&lt;/sub&gt;]</td>
<td>0.92 ± 0.02</td>
<td>0.96 ± 0.05</td>
<td>0.90 ± 0.03</td>
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<tr>
<td>C(10)mim[FeCl&lt;sub&gt;4&lt;/sub&gt;]</td>
<td>0.98 ± 0.02</td>
<td>1.02 ± 0.04</td>
<td>0.92 ± 0.07</td>
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