

FUNCTIONAL IONIC LIQUIDS AND DEEP EUTECTIC SOLVENTS FOR LUMINESCENCE SENSING APPLICATIONS AND CARBON CAPTURE

Leonhard Long-Heng Sze

Dr. Sheila Baker, Thesis Advisor

ABSTRACT

Novel functional Ionic Liquids (ILs) and Deep Eutectic Solvents (DESs), containing unique properties, were investigated. Eight new salts based on four different β -diketonate anions, each coupled with the choline or tetrabutylphosphonium cation were prepared and fully characterized via ESI-MS, FTIR, and $^1\text{H}/^{13}\text{C}$ NMR. The thermal stabilities and transitions for these β -diketonate salts were explored using DSC and TGA. The inherent binding capability of the β -diketonate allowed for lanthanide recognition in which the coordination with Eu^{3+} resulted in a intensification of luminescence. Additionally, these ILs display prominent color change of the β -diketonate in the presence of an acid source, permitting the visual transduction of local pH changes. Utility for carbon capture was also considered, however, these ILs were essentially incapable of binding CO_2 . Computational studies revealed that the association of CO_2 to the β -diketonate anion was thermodynamically unfavored and sterically hindered.

A DES of choline chloride (ChCl) and glycerol (Gly) along with a superbase was shown to capture up to 124 mg of CO_2 per g of reagents (1.00 mole CO_2 per mole of ChCl and Gly). Different bases and mixture composition were also investigated. The system could also be easily reversed upon heating under nitrogen. The optimal system for CO_2 capture was found to contain a 1:2 ChCl:Gly DES mixture mixed with the superbase, DBN, in a 1:3.5 Gly:DBN molar ratio.

Overall, these newly introduced β -diketonate ILs and DES and superbase mixture showed interesting and useful physicochemical properties applicable to a number of applications.