

## Recent Developments in the Design and Use of Task-Specific Ionic Liquids (TSIL) for Reactive Chemical Separations

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Task-specific ionic liquids are defined as IL which by virtue of a functional group tethered to one or both ions are capable of interacting with dissolved substrates in a specific fashion (Davis, et al., Paper No.14F, *Proceedings of the Symposium on Advances in Solvent Selection and Substitution for Extraction*, March 5-9, 2000, Atlanta, Georgia. AIChE, New York, 2000). In a recent series of papers, we have demonstrated the design, synthesis and utilization of TSIL in a variety of synthetic and separations applications. These include benzoin condensation catalysis (Forrester, et al., *Tet. Lett.* 1999, 40, 1621), strong acid catalysis (Cole, et al., *J. Am. Chem. Soc.*, 2002, 124, 5962), extraction of metal ions from aqueous biphasic systems (Visser, et al., *Envir. Sci. Technol.*, 2002, 36, 2523; *Chem. Commun.*, 2001, 135) and the reactive capture of CO<sub>2</sub> (Bates, et al., *J. Am. Chem Soc.* 2002, 124, 926).

In all the aforementioned cases, the TSIL is designed from the ground-up to incorporate a functional group appropriate to give rise to the type of interaction desired between the TSIL and the planned substrate/solute. In the case of TSIL used for separations, these functional groups are commonly species capable of forming covalent or coordinate covalent (dative) bonds with the substrate. For example, some TSIL used for metal ion extraction have incorporated Lewis basic thiourea groups capable of coordinating to the target metal cations. In the case of acid gas capture (specifically CO<sub>2</sub>), the groups have been appended amines.

The first generation of amine appended IL proved to be somewhat tedious to prepare and purify. Consequently, we have been engaged in an effort to develop alternative synthetic approaches to these compounds, with encouraging results. Further, we have found that TSIL incorporating appended hydrazide groups are easy to prepare and purify, and have a reactivity profile for separations similar to that of the amine appended TSIL. In our talk, we will outline the newest approaches for the synthesis of TSIL amines, as well as the syntheses of the new TSIL hydrazide complexes. Further, we will report our results on the use of these and other compounds for the reactive separations of CO<sub>2</sub> as well as other organic carbonyl-containing compounds.