Phase Equilibria Measurements of Pentafluoroethane and Difluoromethane in Ionic Liquids

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Refrigerants are an essential part of our daily lives that are used in a variety of applications such as comfort cooling, food preservation, vaccine storage, and a variety of other commercial and industrial applications. Hydrofluorocarbon (HFC) refrigerants are currently being phased out due to their high Global Warming Potential (GWP). As a result, millions of tons of HFC mixtures will need to be recycled. The challenge is most of these mixtures are azeotropic or near-azeotropic making it difficult to impossible to completely separate the components using distillation. A promising approach to separating azeotropic HFC mixtures utilizes ionic liquids. Ionic liquids are unique advanced materials with essentially no measurable vapor pressure, capable of dissolving many organic and inorganic compounds, with variable solubility of gases and liquids, and high thermal, chemical, and electrochemical stability. These properties make ionic liquids uniquely suited as entrainers for the separation of HFC azeotropic mixtures such as R-410A, which is composed of 50 wt.% HFC-125 (CHF_2CF_3) and 50 wt.% HFC-32 (CH_2F_2). Development of highly selective separation processes will allow low-GWP refrigerants such as HFC-32 to be recycled and utilized in new environmentally friendly refrigerant blends with low-GWP hydrofluoroolefins. High-GWP refrigerants such as HFC-125 can be repurposed into new high-value fluorinated materials.

This presentation will cover phase equilibria measurements for HFC-32 and HFC-125 with a variety of imidazolium based ILs. Solubility data for single component HFCs were measured using a Hiden Isochema IGA gravimetric balance. Multicomponent HFC phase equilibria data were measured using a Hiden Isochema XEMIS balance with the new Integral Mass Balance (IMB) method (the first instrument of its kind). Diffusion results have been calculated using kinetic data from both the IGA and XEMIS IMB and selectivity differences between pure HFC+IL and binary HFC+IL mixture measurements will be discussed.