

A Novel Method of Chemical Processing: Miscibility Switches in Ionic Liquids

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A new method of chemical processing is presented, which uses ionic liquids and supercritical carbon dioxide as combined reaction and separation media. In this process, the carbon dioxide pressure controls the miscibility of reactants, products and catalyst and ionic liquid. A homogeneous liquid phase is reached at high carbon dioxide pressures, resulting in fast reactions without any mass transfer limitations over interfaces. Moreover, adding carbon dioxide to the reacting system increases the solubility of reactants in ionic liquids and decreases the viscosity of the ionic liquid, resulting in even faster reaction rates. At lower carbon dioxide pressures instantaneous demixing into two phases (liquid phase + vapor phase) is observed. The vapor phase contains product and carbon dioxide, but does not contain any ionic liquid, because the vapor pressure of ionic liquids is negligibly low. Therefore, pure product can be recovered by precipitation from the vapor phase by further pressure release. The catalyst remains in the ionic liquid phase and can be easily recycled without negatively affecting the activity and selectivity. Also, the carbon dioxide can be recompressed and reused. An advantage of instantaneous demixing over conventional extraction with carbon dioxide is the higher rate of product separation from the ionic liquid. Compared to conventional chemical processing, the energy consumption in the new set-up is decreased with 75%, because no distillation steps are necessary. The new process set-up is applicable to many industrial processes.