Supporting information

Advanced ionic liquid technologies for sustainable reaction intensification

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Table S1. Representative Case Studies of Reaction Intensification Using Ionic Liquids: Mechanisms and Performance Metrics

Reaction Type	Specific Example	Ionic Liquid (Function)	Performance Enhancement & Mechanistic Insight	Ref.
Esterification	Acetic acid + Ethanol → Ethyl Acetate	[BMIM][HSO_4] (Brønsted Acid Catalyst & Solvent)	Rate Enhancement: Superior to conventional acids. Mechanism: Combined acid and phase-transfer functionality.	[1]
Diels-Alder Cycloaddition	Cyclopentadiene + Methyl Acrylate	[BMIM][PF_6] (Lewis Acid Catalyst & Solvent)	Rate/Selectivity: Drastically accelerated with controlled stereoselectivity Mechanism: Dienophile activation through Lewis acid-carbonyl interaction.	[2]

Reaction Type	Specific Example	Ionic Liquid (Function)	Performance Enhancement & Mechanistic Insight	Ref.
Friedel-Crafts Alkylation	Isobutane + 2-Butene	Chloroaluminate ILs (Superacidic Catalyst & Solvent)	Selectivity: High for desired products. Mechanism: Transition-state stabilization in confined environment.	[3]
Heck Cross-Coupling	Iodobenzene + Styrene	Palladium Acetate in ILs (Reaction Medium & Catalyst Stabilizer)	Catalyst Stability: Long-term stability with minimal leaching. Mechanism: Nanoparticle stabilization and facile separation.	[4]

Reaction Type	Specific Example	Ionic Liquid (Function)	Performance Enhancement & Mechanistic Insight	Ref.
Hydrogenation	Cyclohexene → Cyclohexane	Rhodium Nanoparticles in ILs (Catalyst Dispersion Medium)	Catalyst Reusability: Maintained conversion with facile separation. Mechanism: Dual electrostatic and biphasic stabilization.	[5]
Hydroformylation	1-Octene → Nonanal	Rh/TPPTS Complex in ILs (Catalyst Immobilization Phase)	Selectivity : High linear selectivity and robust stability. Mechanism: Biphasic catalyst confinement.	[6]

References

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