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Research topic and interests

My research focuses on the sustainable synthesis and characterization of bio-based ionic liquids to be used as advanced phase change materials (PCMs) for thermal energy storage.

I specialize in valorizing industrial by-products and waste streams to derive organic building blocks for the synthesis of advanced ionic compounds. My core interest lies in advancing green chemistry principles by designing innovative thermal energy storage materials with tunable thermophysical properties to replace fossil-based alternatives.



Circular economy



Sustainable waste valorisation



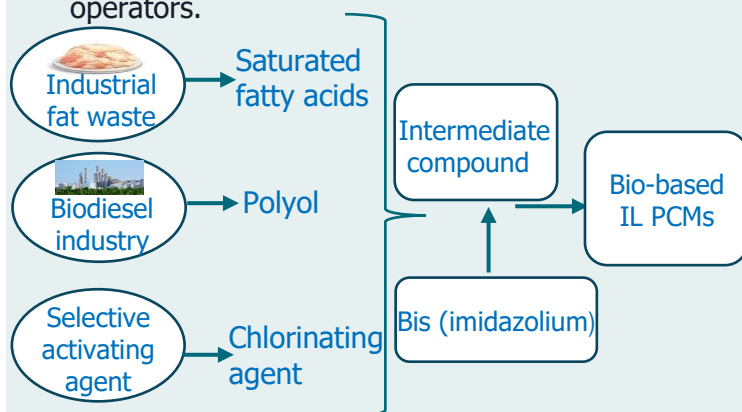
Thermal energy storage

Key areas of expertise

- Chemical synthesis: expertise in targeted chemical transformations under controlled conditions, including the simultaneous esterification-chlorination of fatty acids and biodiesel polyols, as well as nucleophilic substitution routes.
- Purification and process optimization: proficiency in the purification, crystallization, and optimization of operating conditions for bio-based ionic liquid PCMs.
- Green chemical processing: proven capability in valorizing industrial and agricultural waste streams (such as animal fats, vegetable by-products, and crude glycerol) to convert waste lipids into high-performance functional materials.
- Chemical structural analysis: competence in confirming target chemical structures and high purity using high-field ^1H -NMR spectroscopy.
- Methodological reliability & scalability: validated the repeatability, reproducibility, and scalability of synthesis protocols across multiple replicates, confirming their stability and suitability for potential industrial-scale production of bio-based ionic liquids.

Current work

- Synthesis of bio-based ionic liquids: using fatty acids (e.g., stearic and palmitic acids) derived from animal waste and vegetable by-products to synthesize tunable ionic liquid salts.
- Material characterization & thermophysical evaluation: structural confirmation via ^1H -NMR coupled with the assessment of melting behavior, latent heat capacities, and thermal stability to optimize moderate-temperature thermal energy storage systems. Experimental reliability and reproducibility are validated through multi-replicate synthesis across varying dates and operators.



Key projects and achievements

- Project contribution: developing bio-based ionic liquids as innovative PCMs featuring high energy storage density, enhanced thermal stability, tuneable transition temperatures, and negligible vapor pressure within a circular economy framework.
- Waste valorization & synthesis: successfully converted agro-industrial waste lipids and polyols into functional bio-based ionic compounds to replace fossil-derived materials in TES.
- Repeatability and reproducibility in the synthesis of the developed bio-based ionic liquids.
- Validated the scalability of the synthesis protocol.

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