

## Ionic Liquid-Assisted Thermal Degradation and Recycling of Polypropylene: A Study using 1-Ethyl-3-Methylimidazolium Acetate

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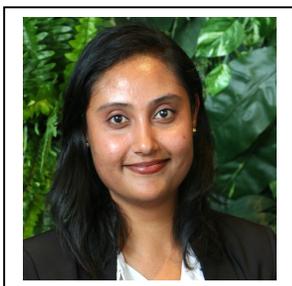
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In alignment with circular economy goals for plastic waste valorisation, this study explores the chemical interaction between polypropylene (PP) and an ionic liquid (IL), 1-ethyl-3-methylimidazolium acetate (EMIM Ac), through both thermal treatment and extrusion. ILs have emerged as novel solvents and reactants for polymer modification and degradation due to their tunable chemical properties and non-volatility.<sup>1,2</sup> In this work, virgin PP and extruded PP were separately heated with EMIM Ac under controlled conditions to examine potential degradation pathways and structural transformations. The treated samples were characterized using thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), Fourier-transform infrared spectroscopy (FTIR), nuclear magnetic resonance spectroscopy (NMR), and gas chromatography–mass spectrometry (GC-MS). TGA profiles revealed a significant alteration in thermal degradation behaviour, suggesting partial depolymerization or oxidative degradation. DSC results showed shifts in melting and crystallization behaviour, suggesting changes in crystalline structure. FTIR spectra showed the appearance of oxygenated functional groups, possibly introduced through IL-mediated bond cleavage. GC-MS confirmed the formation of low molecular weight fragments and oxidized species, highlighting the role of EMIM Ac in promoting PP degradation. Further, FTIR and NMR studies on the residual EMIM Ac provided a promising approach for the reusability of the IL. These findings demonstrate a novel route for PP recycling and functionalization using ILs, offering insights into more efficient recycling methodologies.<sup>3</sup>

### References

1. Kubisa, P. *J. Polym. Sci., Part A: Polym. Chem.* **2005**, 43 (20), 4675–4683.
2. Donato, R. K.; Benvegnú, M. A.; Furlan, L. G.; Mauler, R. S.; Schrekker, H. S. *J. Appl. Polym. Sci.* **2010**, 116 (1), 304–307.
3. Christoff-Tempesta, T.; Epps, T. H. *ACS Macro Lett.* **2023**, 12 (8), 1058–1070.



Moon Paul commenced her PhD in 2023 at the Institute for Frontier Materials, Deakin University, Australia. She holds a master's degree in Nanotechnology from KTH Royal Institute of Technology, Stockholm, Sweden, and a Bachelor of Technology from SRM University, India. She has a strong background in synthesizing and characterizing nanomaterials, with experience focusing on sustainable materials production in recycled plastic boards, graphene composites, and nanotech-based coatings.