Carbon dioxide gas conversion to polycarbonate-block-ester terpolymer

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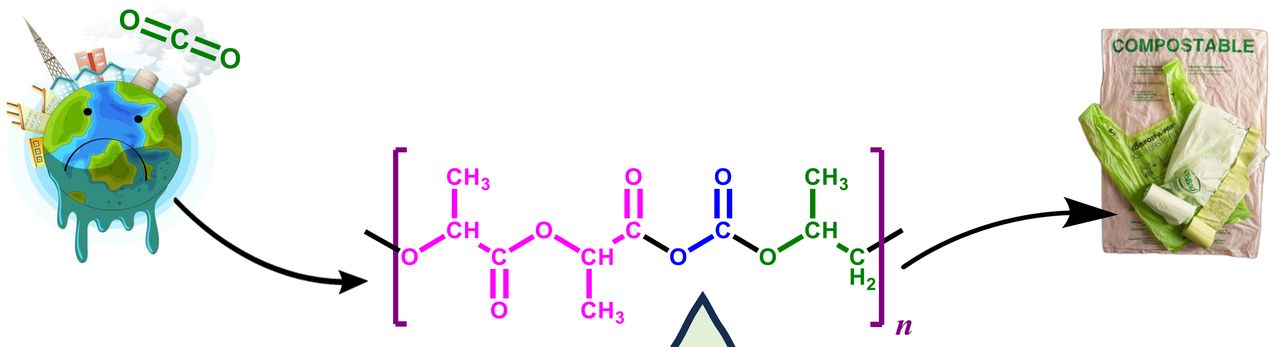
CEEMS

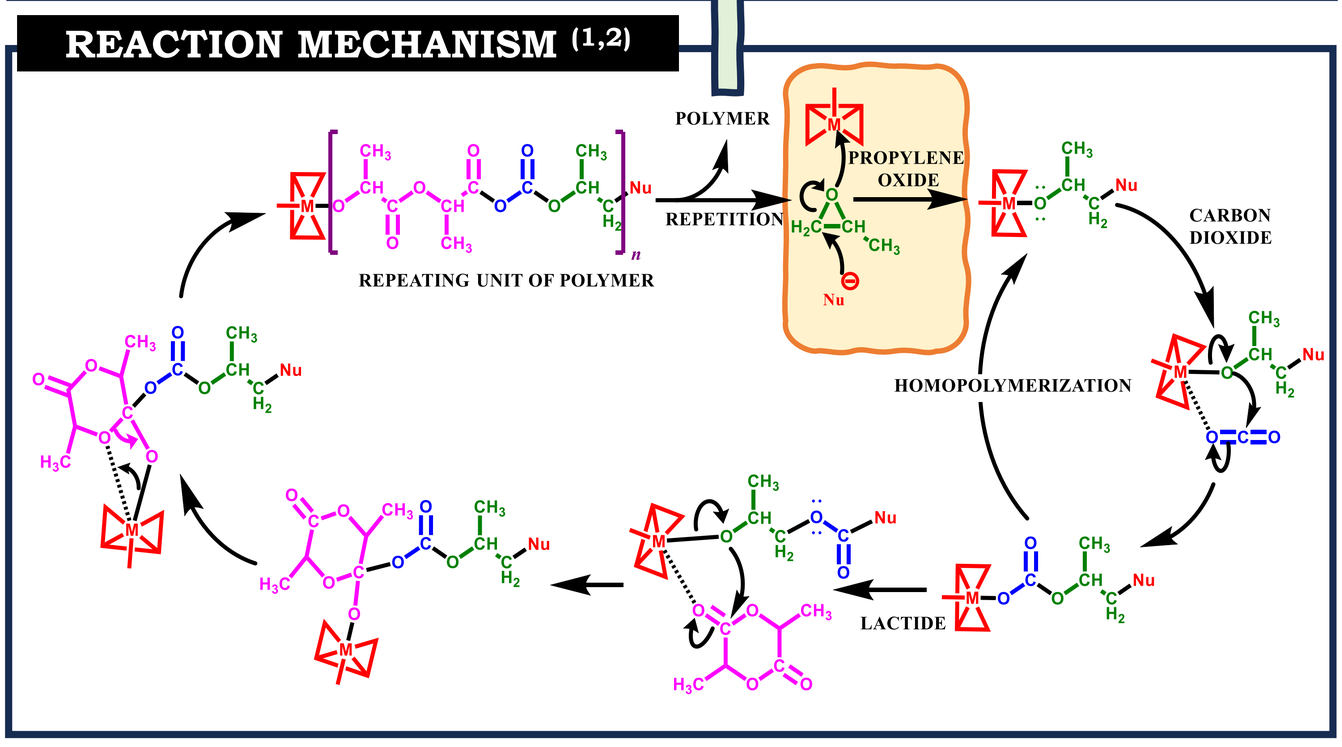
AIM OF THE STUDY

Carbon Capture and Utilization (CCU) is a strategy currently employed to mitigate global warming. This technique involves using captured carbon dioxide to synthesize valuable products. Our research group focuses on synthesizing a polymer called polycarbonate from carbon dioxide. While this approach helps address carbon dioxide emissions, the resulting polycarbonate has a low glass transition temperature, limiting its applicability. To enhance its utility, we incorporate a crystalline segment, L-lactide, into the polymer chain, which overcomes this limitation.

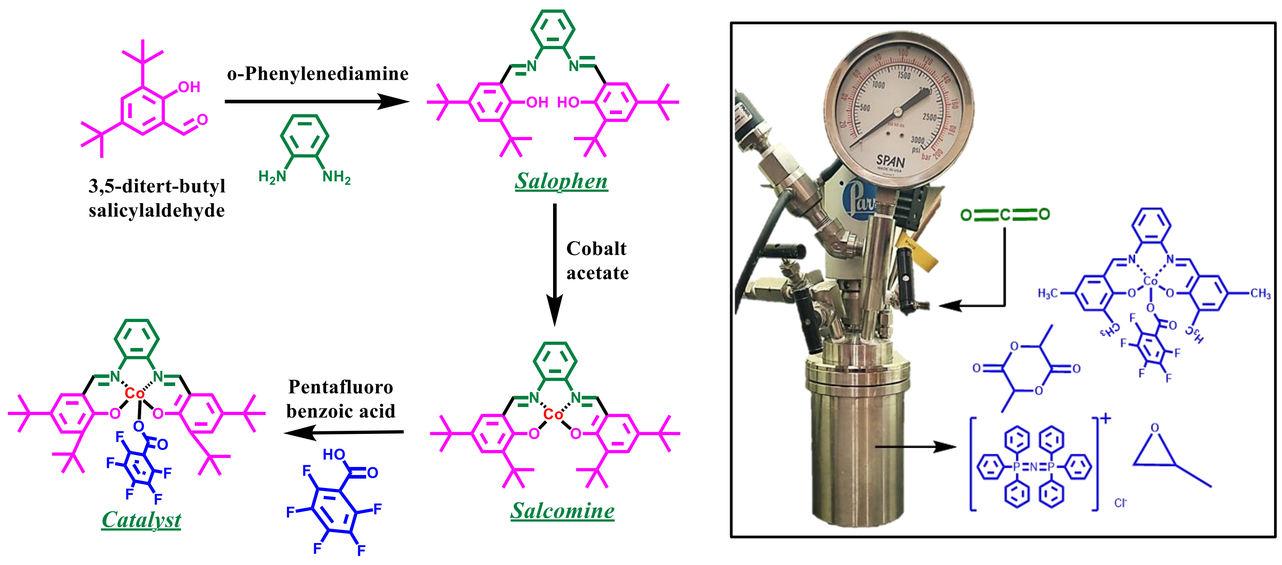
A tandem co-polymerization utilizing a one-pot, one-step approach has been investigated. A catalytic system with both Lewis acidic and basic sites was developed, capable of independently facilitating the ring-opening of L-lactide and propylene oxide.



REACTION MECHANISM (1,2)



SYNTHESIS



CHARACTERIZATIONS OF CATALYTIC SYSTEM

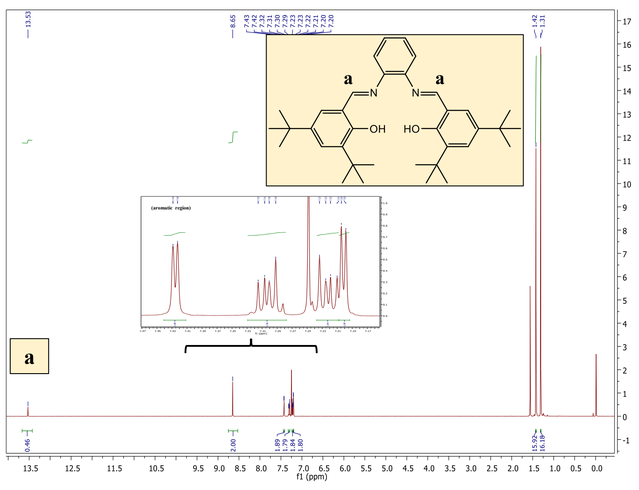


Fig 1: 1H-NMR of Salophen compound

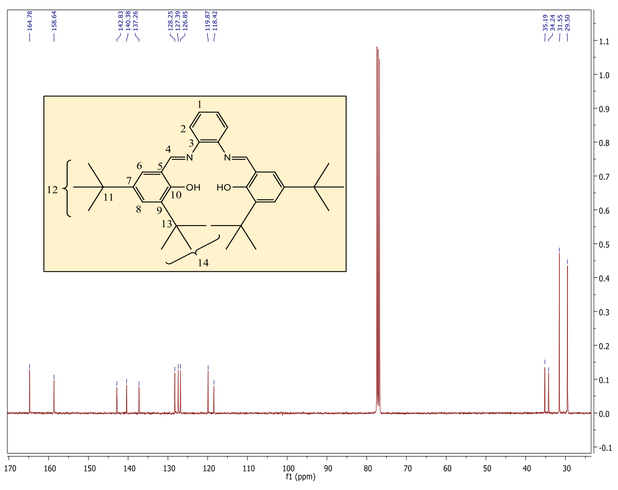


Fig 2: 13C-NMR of Salophen compound

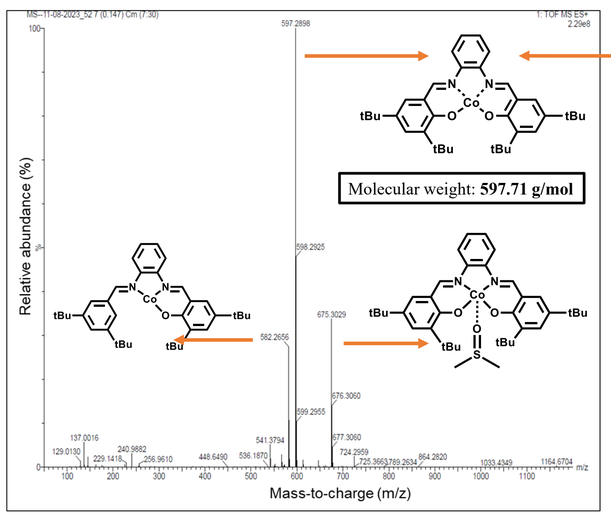


Fig 3: ESI (+) HRMS spectra of Salcomine

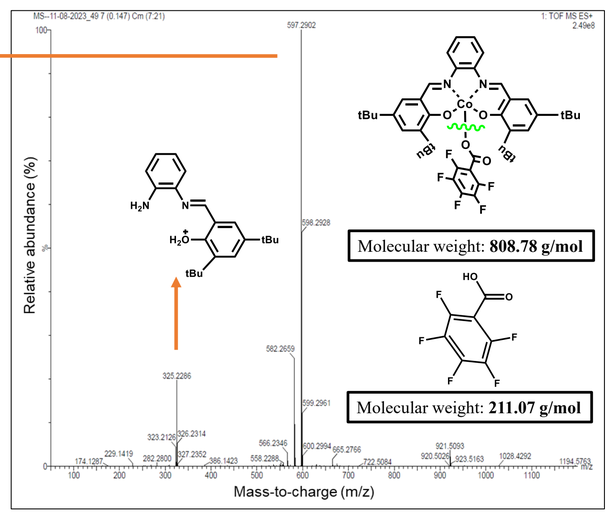


Fig 4: ESI (+) HRMS spectra of Catalyst

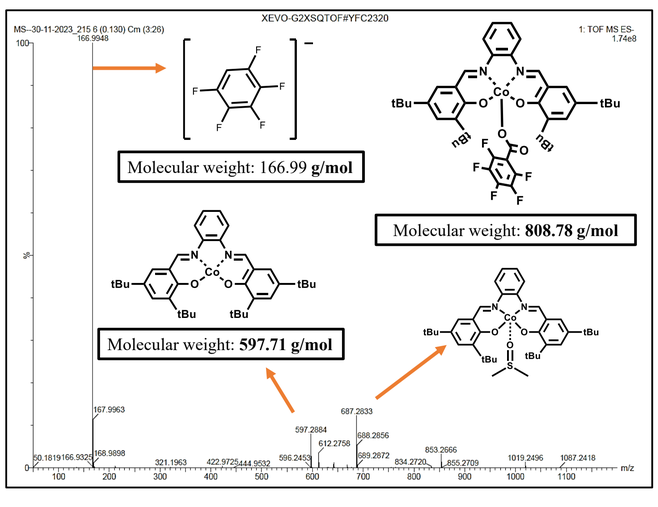
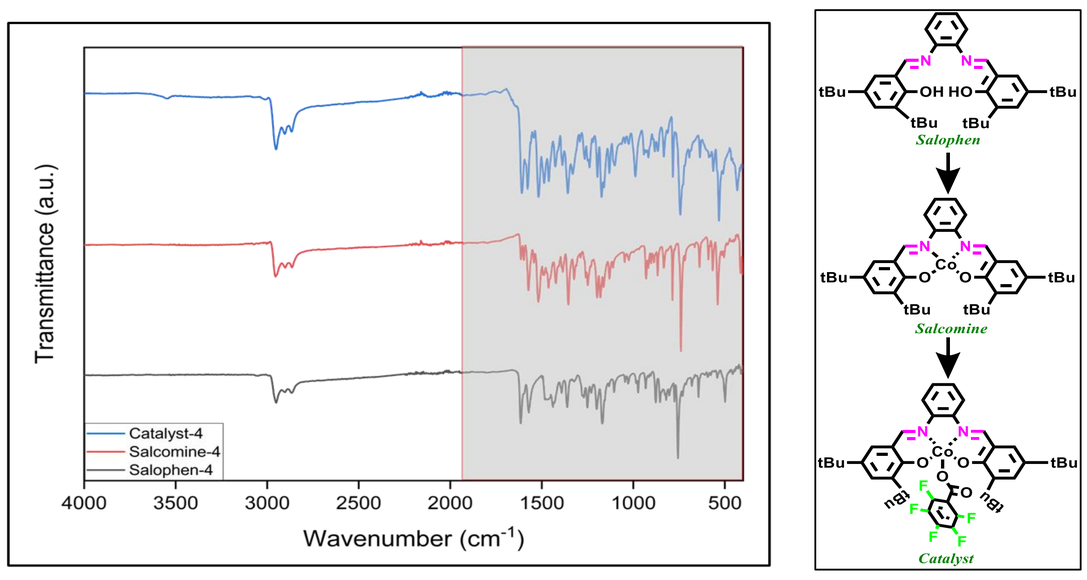


Fig 5: ESI (-) HRMS spectra of Catalyst

CHARACTERIZATIONS OF CATALYTIC SYSTEM



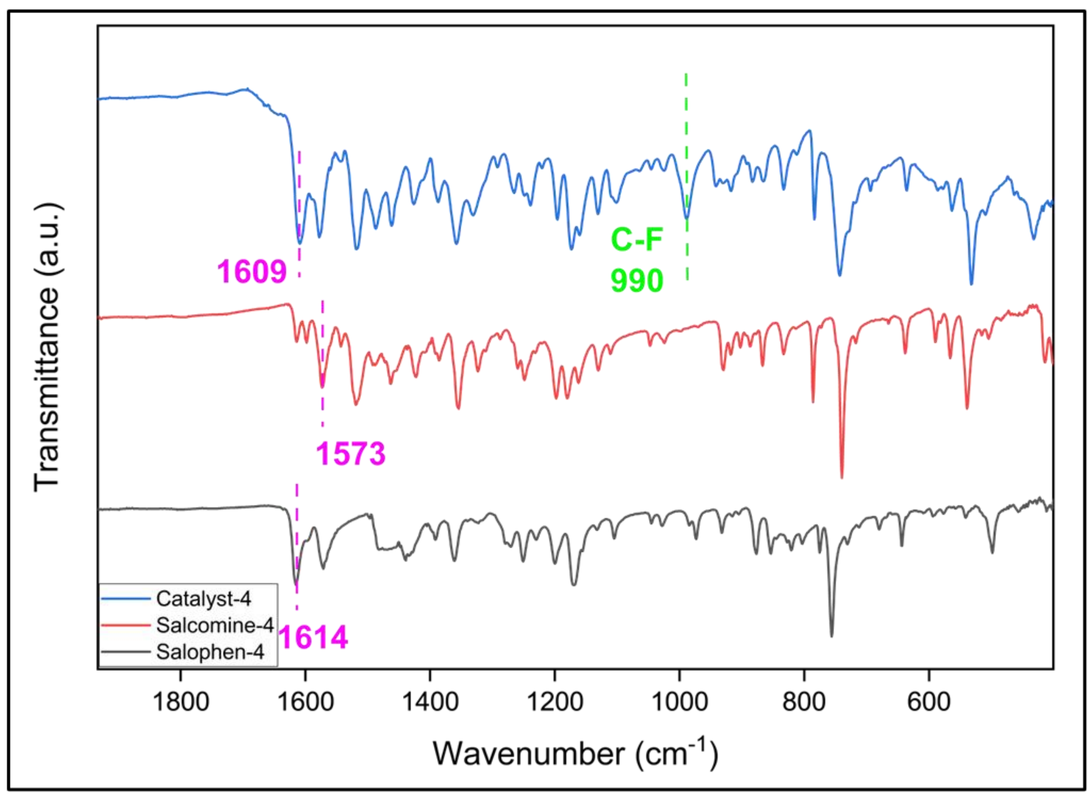


Fig 6: Stacked ATR-FTIR spectra of Salophen, Salcomine and Catalyst

CHARACTERIZATIONS OF POLYMER

PLA : 5.15 ppm (CH−), 1.55 ppm (CH3−),

PPC : 4.97 ppm (CH−), 4.20 ppm (CH2−), 1.30 ppm (CH3−)

PPO : 3.50 ppm (CH−CH2−), 1.20 ppm (CH3−).

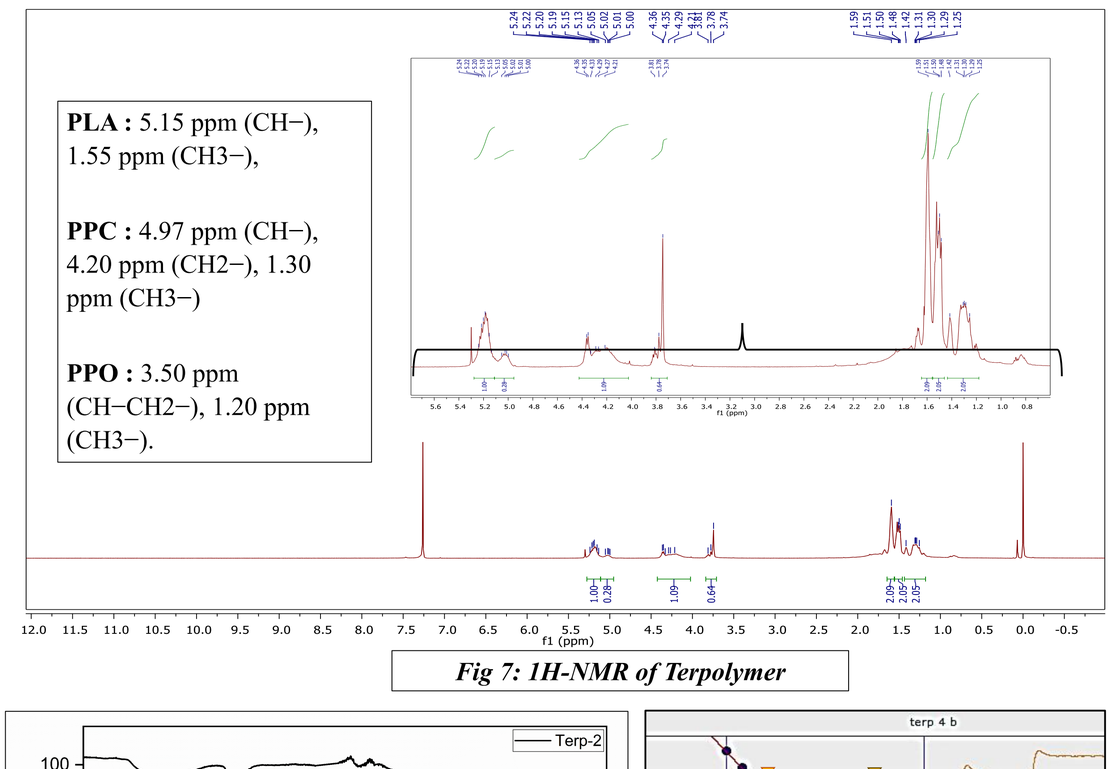


Fig 7: 1H-NMR of Terpolymer

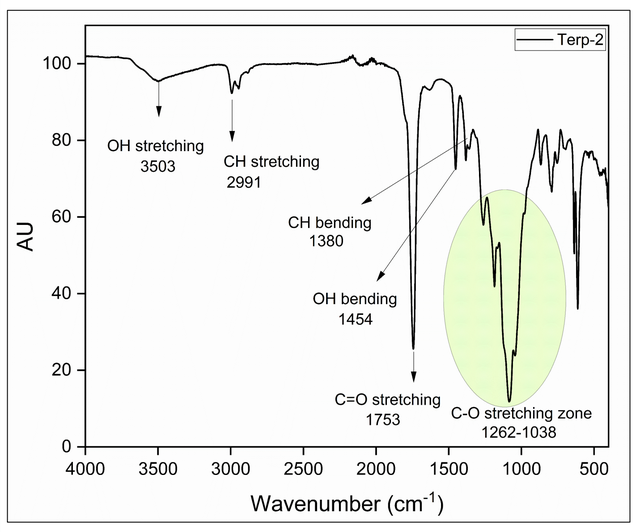
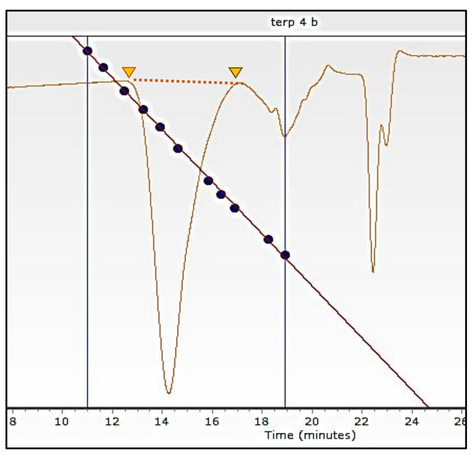


Fig 8: ATR-FTIR of Terpolymer



M_n	M_w	PDI
61,362 g/mol	1,23,996 g/mol	2.02

Fig 9: GPC Results of Terpolymer

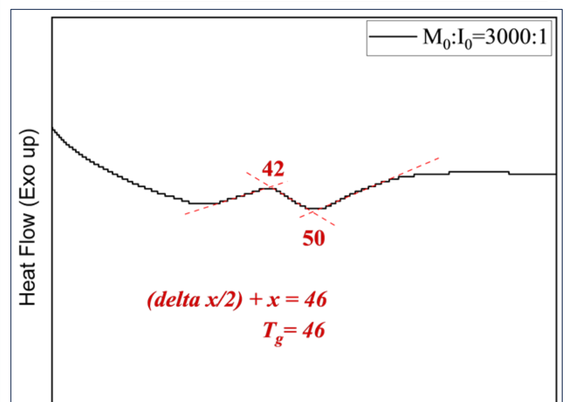
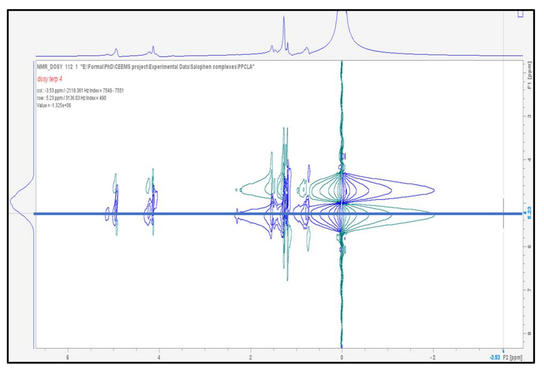


Fig 10: DSC of Terpolymer



Common diffusion coefficient at 5.23 ppm diffusion unit

Fig 11: DOSY-NMR of Terpolymer

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1. Chisholm, M. H., & Zhou, Z. (2004). Concerning the mechanism of the ring opening of propylene oxide in the copolymerization of propylene oxide and carbon dioxide to give poly (propylene carbonate). *Journal of the American Chemical Society*, *126* (**35**), 11030-11039.
2. Gupta, A. P., & Kumar, V. (2007). New emerging trends in synthetic biodegradable polymers–Polylactide: A critique. *European polymer journal*, *43* (**10**), 4053-4074.

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