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Depolymerization process of low molecular weight PLA through hydrolysis

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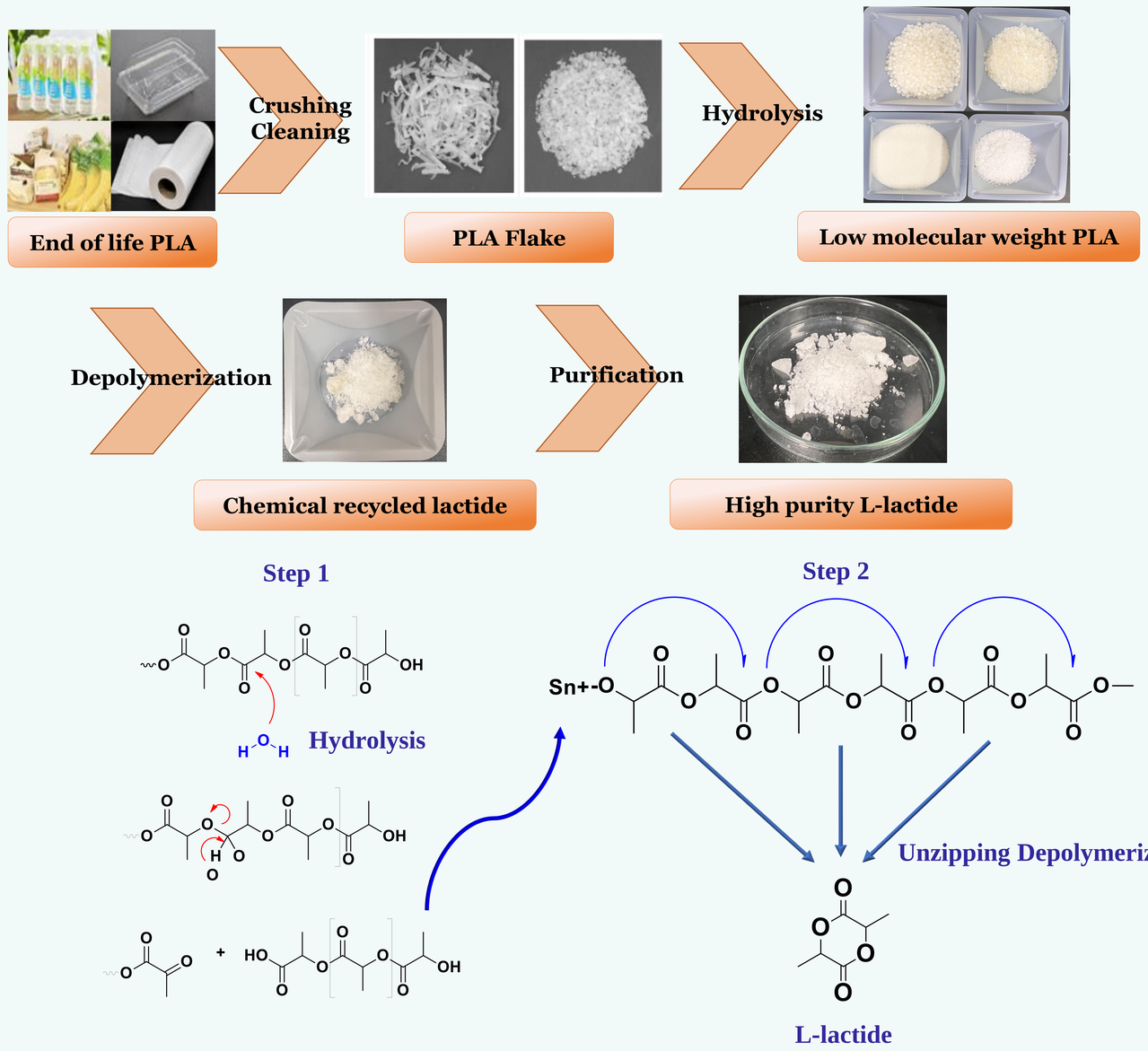
ABSTRACT

High purity lactide was synthesized through chemical recycling of polylactic acid (PLA) in life. Recycled PLA made into pellets/flakes through physical processing was decomposed to a Mn- 5,000 about 24h at 100 ℃, and the molecular weight tended to decrease as the time and temperature of hydrolysis increased. Low molecular weight PLA was able to produce L-lactide through a back-biting mechanism using a Sn/Zn-based organometallic catalyst. D-, L-, and meso-lactide isomers are produced from chemical recycled PLA, and the L-form was mainly analyzed because it has excellent mechanical properties. High performance liquid chromatography was used to confirm the purity of the regenerated lactide, and nuclear magnetic resonance was used for structural analysis. High purity lactide could be produced by removing impurities through the purification process using a solvent.

OBJECTIVES

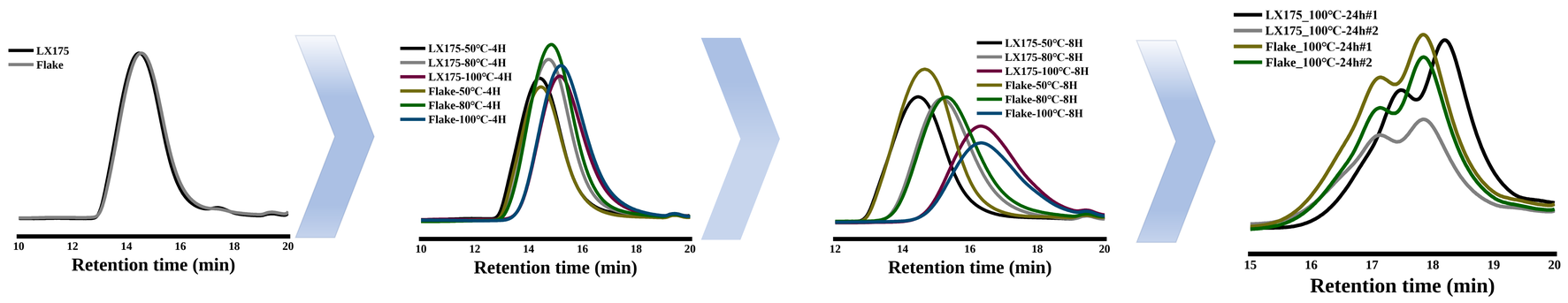
1. Carbon and energy savings from recycling end of life PLA
2. Improving the properties of high-purity PLA by chemical recycling
3. Optimization of high purity l-lactide synthesized under depolymerization reaction conditions (catalyst, temperature, etc.)
4. A high purity lactide is obtained through a purification process using a suitable solvent

EXPERIMENTAL



RESULTS

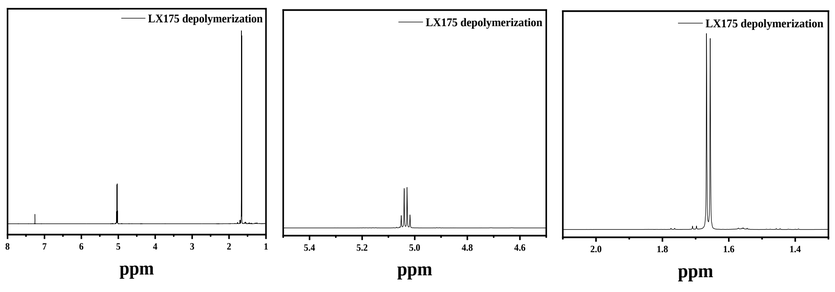
Hydrolysis PLA - GPC



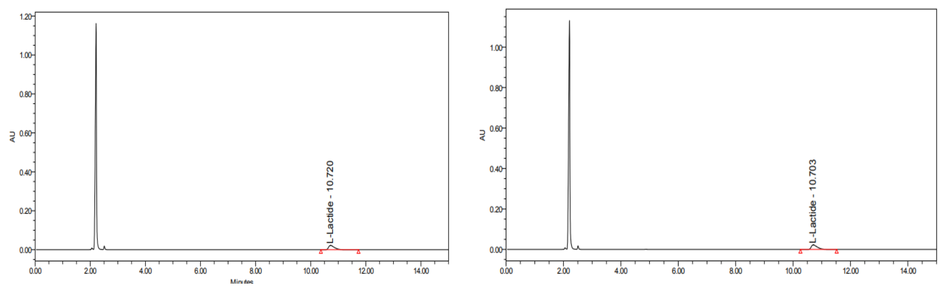
<Hydrolysis PLA molecular weight>

	Time (t)	temperature (℃)	Mn	Mw	PDI
LX175	4	100	36411	59211	1.63
	8	100	12264	21395	1.74
	24	**100**	**3346**	**7050**	**1.83**
Flake	4	100	35282	57853	1.64
	8	100	10421	20351	1.95
	24	**100**	**3497**	**6809**	**1.94**

Re-Lactide - NMR



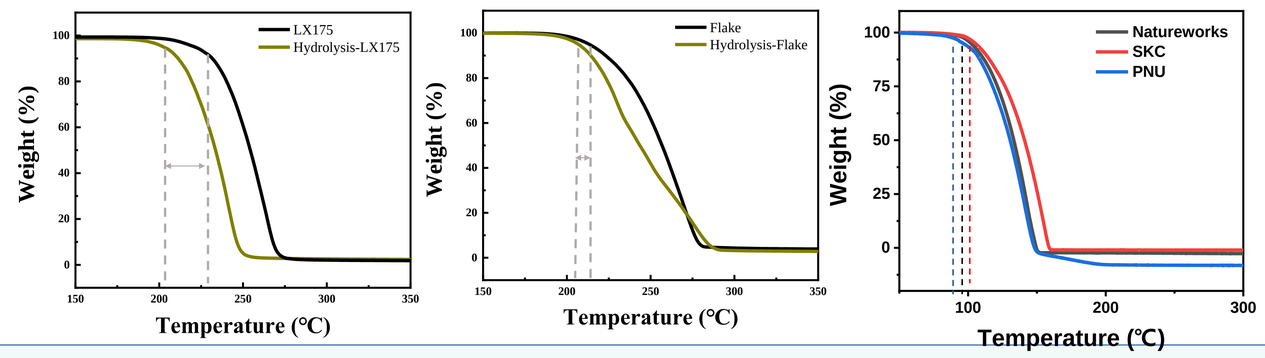
Re-Lactide - HPLC



<L-lactide purities >

Sn catalyst	Ethanol	Ethanol : Water
#1-1	**97.98**	92.19
#1-2	**98.49**	92.22
#1-3	**98.49**	92.73
#2-1	93.53	95.15
#2-2	93.90	95.57
#2-3	94.19	95.71

Hydrolysis PLA and Re-Lactide - TGA



CONCLUSIONS

- ✓ **End of life PLA through physical regeneration was hydrolyzed according to process conditions to produce PLA with a molecular weight of 3,000.**
- ✓ **Depolymerization was performed according to the catalyst type using a low molecular PLA, and a high-purity l-lactide was obtained after a purification process.**

ACKNOWLEDGEMENT

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