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Ring Opening Polymerization

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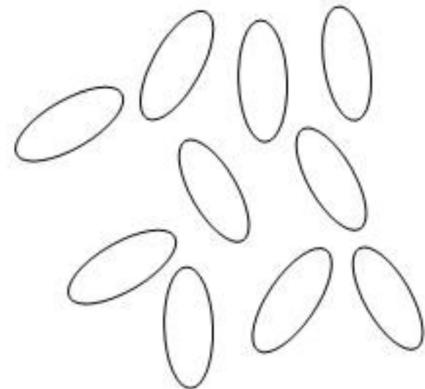
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Ring Opening Polymerization

ZOUA PA VANG

DR. CHRIS SCHALLER



Monomers



Polymer

Introduction

Polymers

- Monomers
- Building blocks
- Lightweight, durable, inexpensive, and easy to make

Introduction

Application

- Clothes
- Plastic bags, bottles
- Food packing bags

Useful but...

Introduction

Increase of use of plastics leads to...

- Damage to the environment
 - Durable, high-performance

Therefore,

Biodegradable polymers

- Degradable
- Sustainable
- Nonharmful

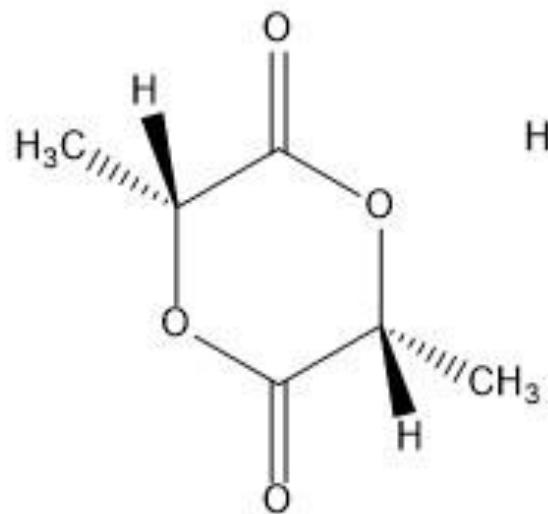
Introduction

Ring-opening polymerization reaction to obtain polymer chains from natural sources

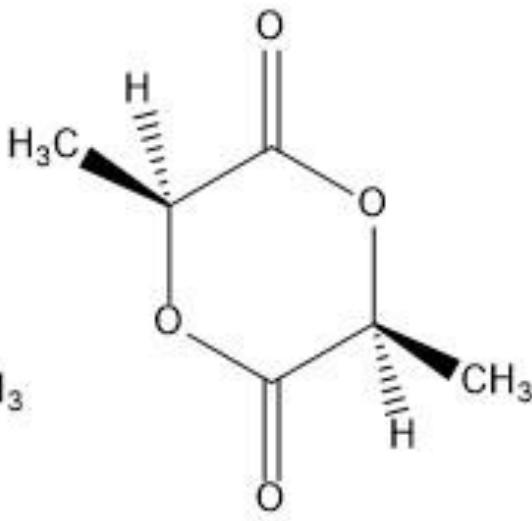
Goal: Control the chain length

- Time and stereochemistry

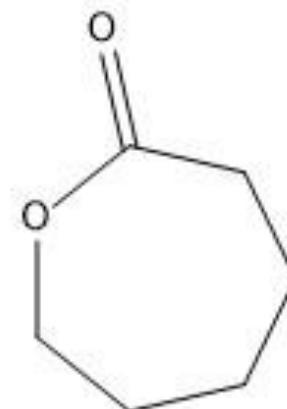
L-lactide



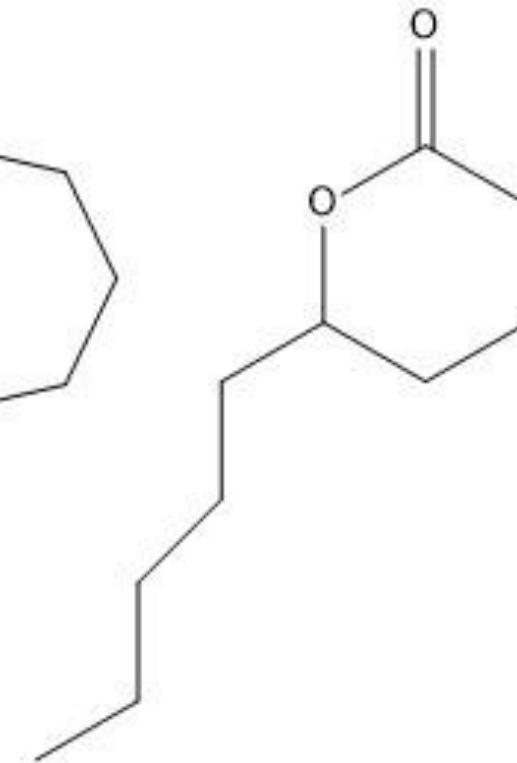
D-lactide



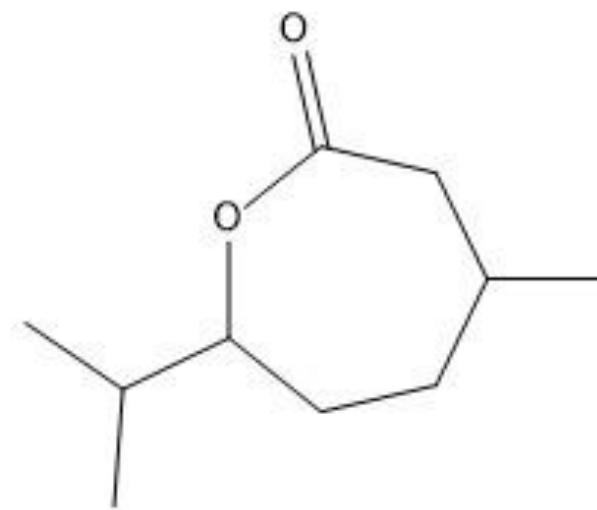
Caprolactone



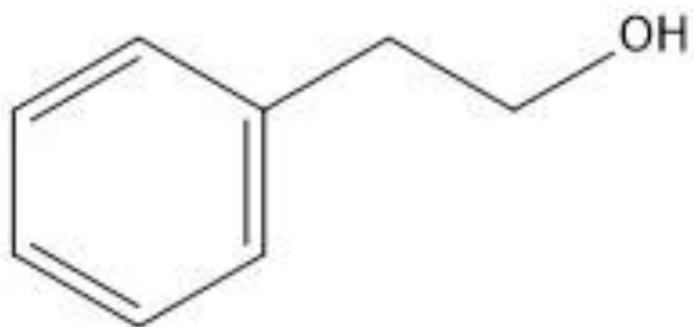
Delta-decalactone



Menthide



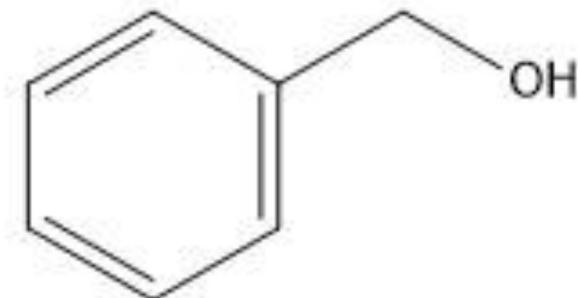
MONOMERS



2-Phenylethanohol

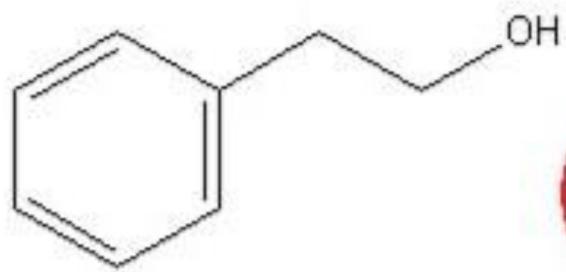


1,4-butanediol

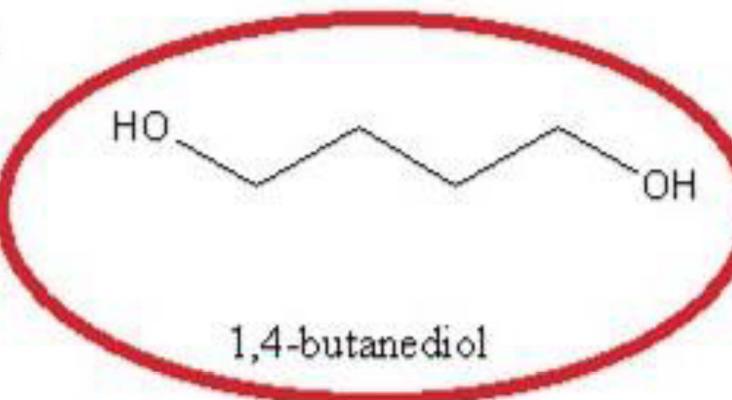


Benzyl Alcohol

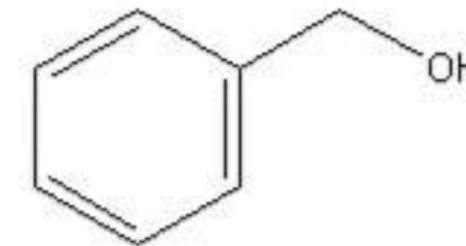
Initiators



2-Phenylethanol



1,4-butanediol



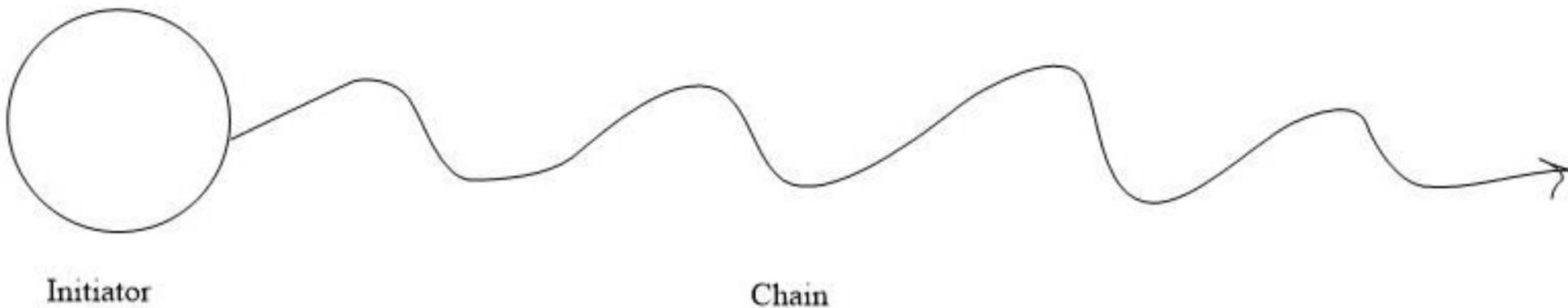
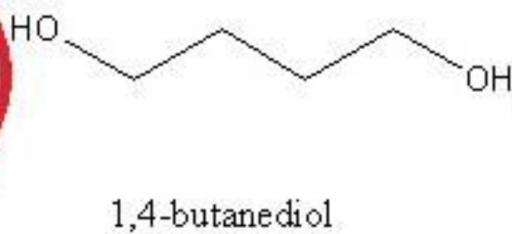
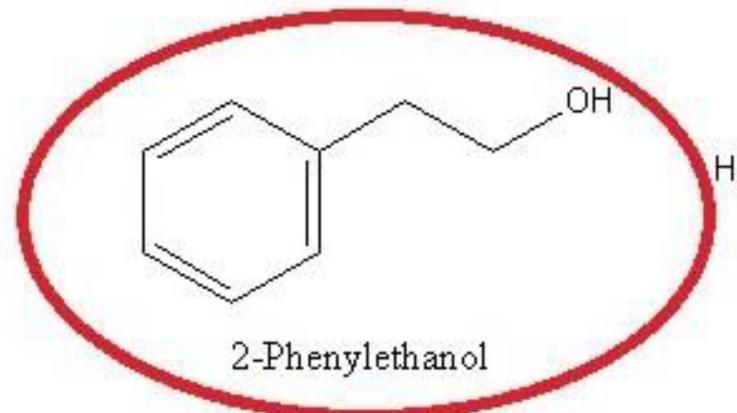
Benzyl Alcohol

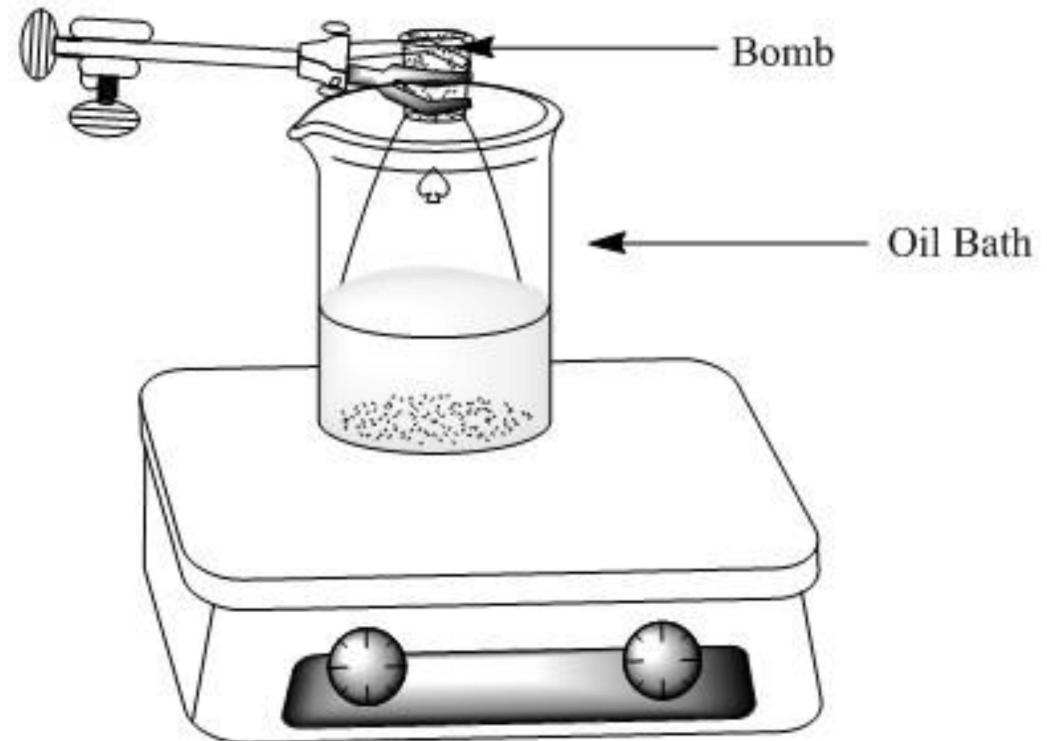
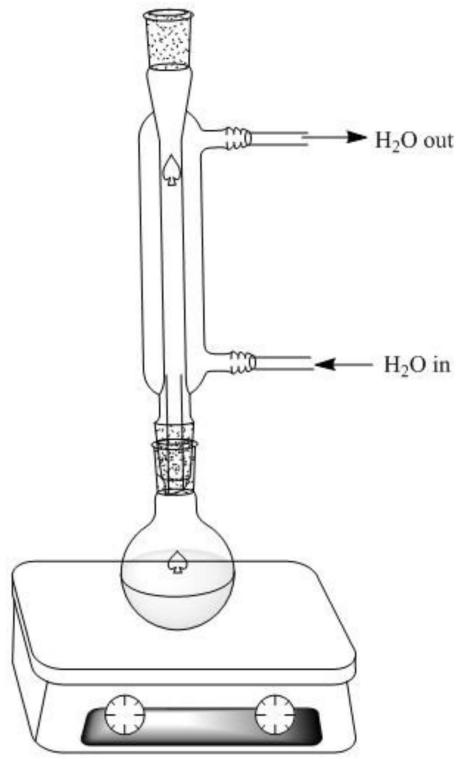
A diagram consisting of a large circle positioned in the center. A wavy line originates from the bottom-left, curves upwards and to the right, then downwards and to the right, ending at a small arrowhead pointing towards the circle. Another wavy line originates from the bottom-right, curves upwards and to the left, then downwards and to the left, ending at a small arrowhead pointing away from the circle.

Chain

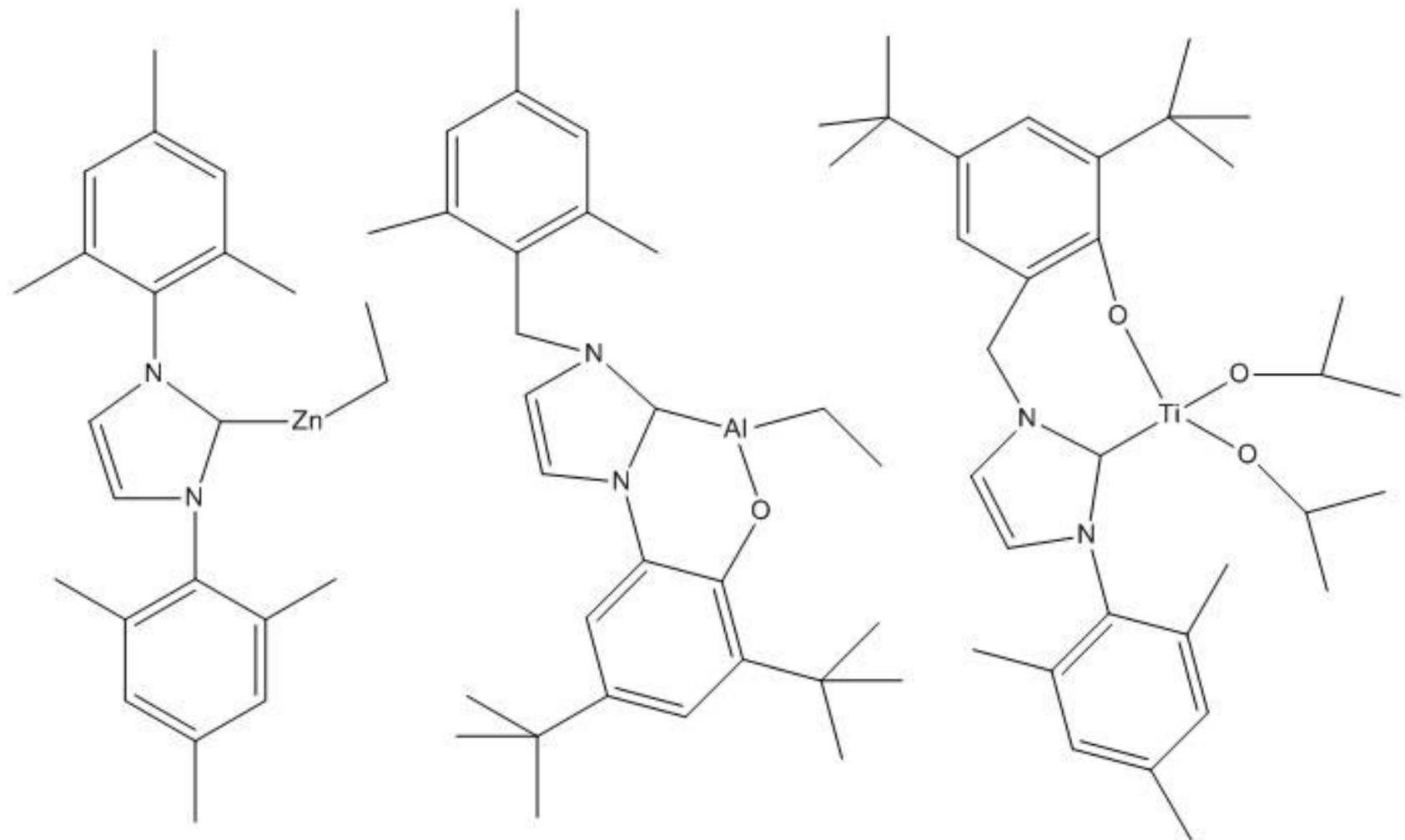
Initiator

Chair



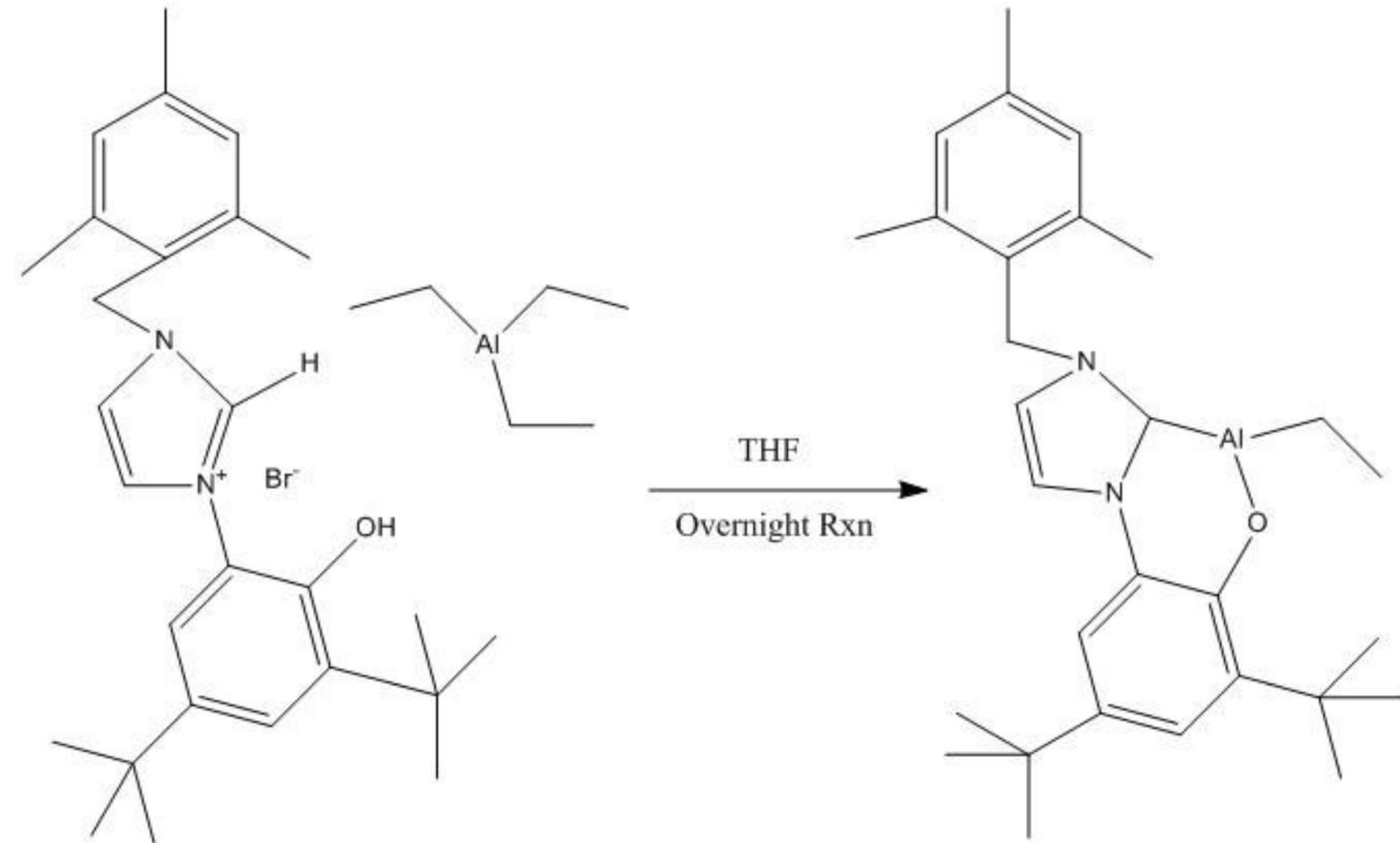


Methods



Catalysts

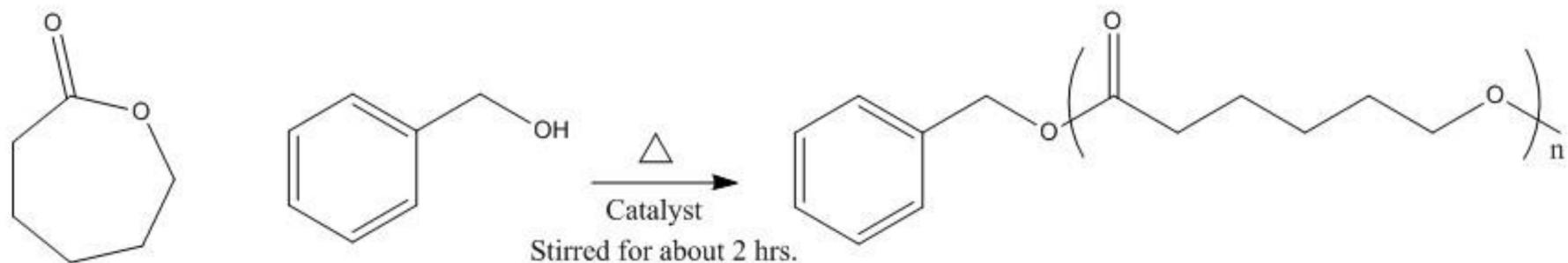
Catalyst used
for reactions
Aluminum Catalyst



Caprolactone & Benzyl alcohol

Degrees of Polymerization (DP): 28

Time: 2hrs

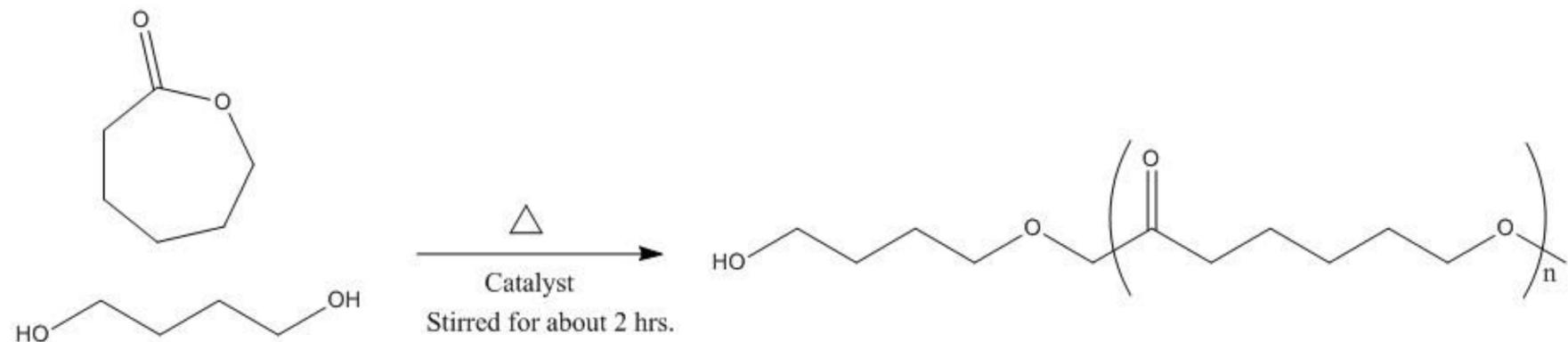


Caprolactone & 1,4-butanediol

DP: 3

Time: 2hrs

Benzyl alcohol vs. 1,4-butanediol?



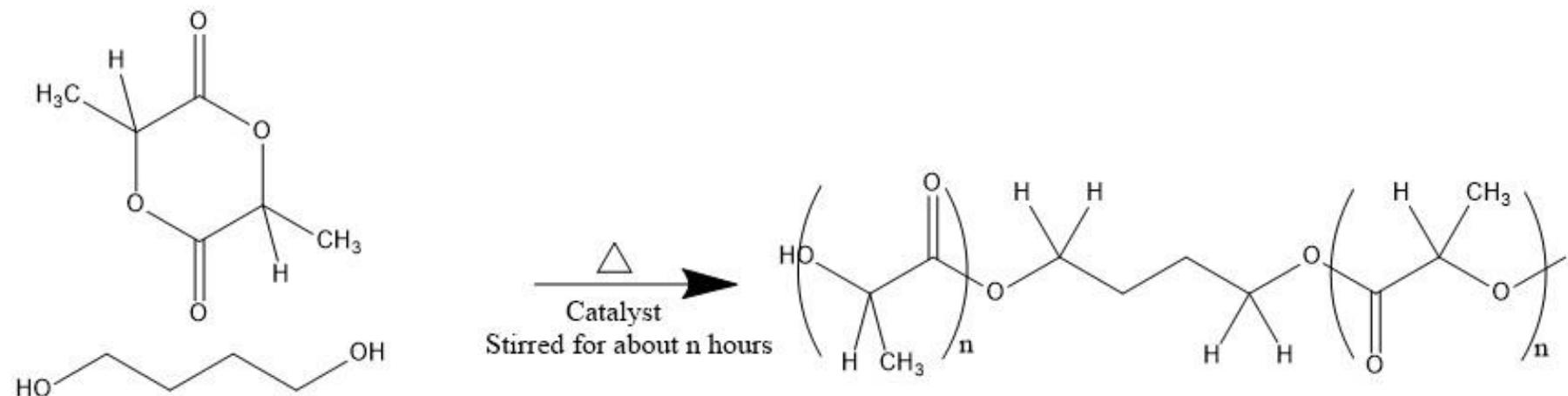
Lactide & 1,4-butanediol

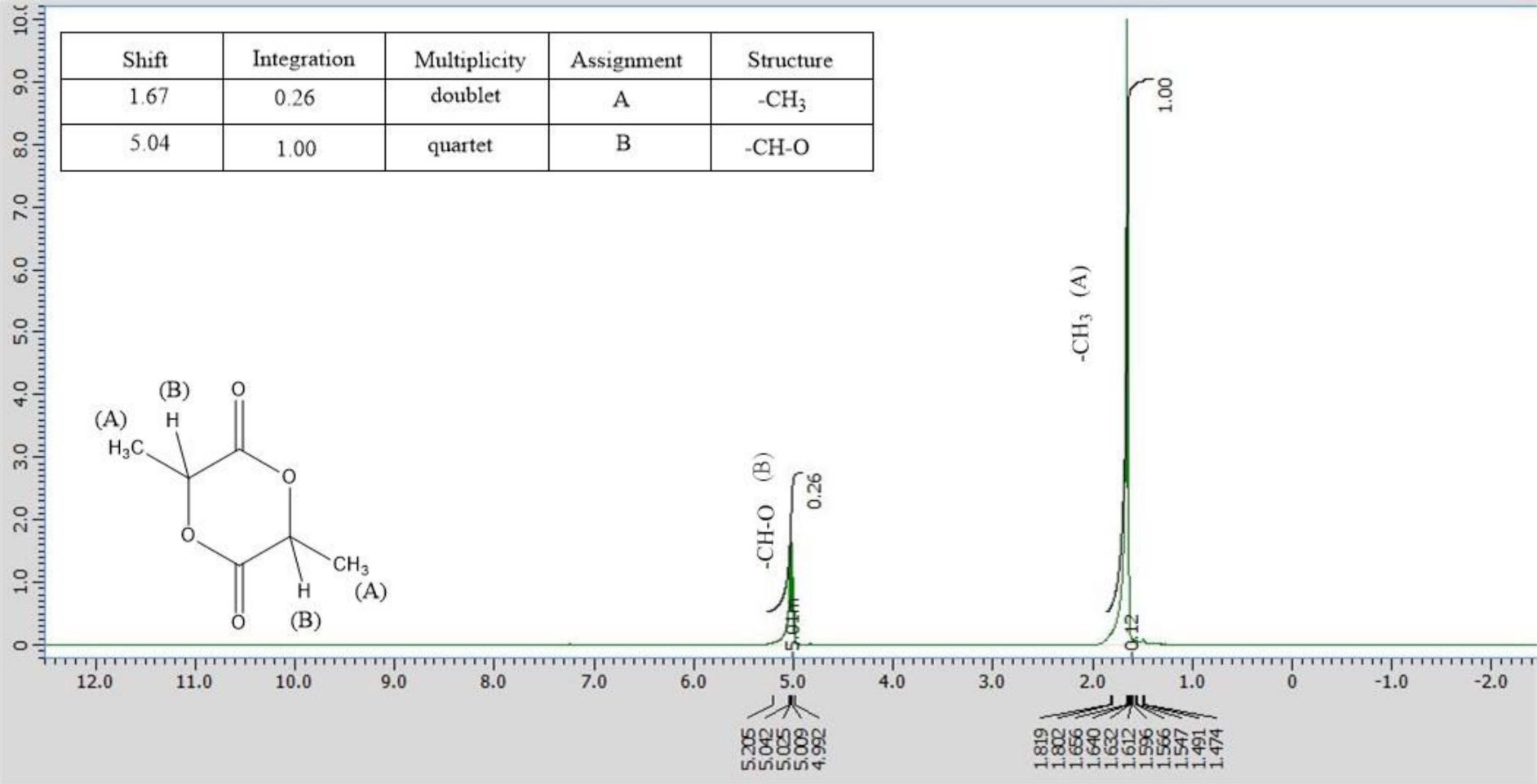
Feed Ratio: 40:1.0:0.5, 20:1.0:0.5

Time: 2hrs, 6hrs, 24hrs, 48hrs

DP: 6.32 – 22.90

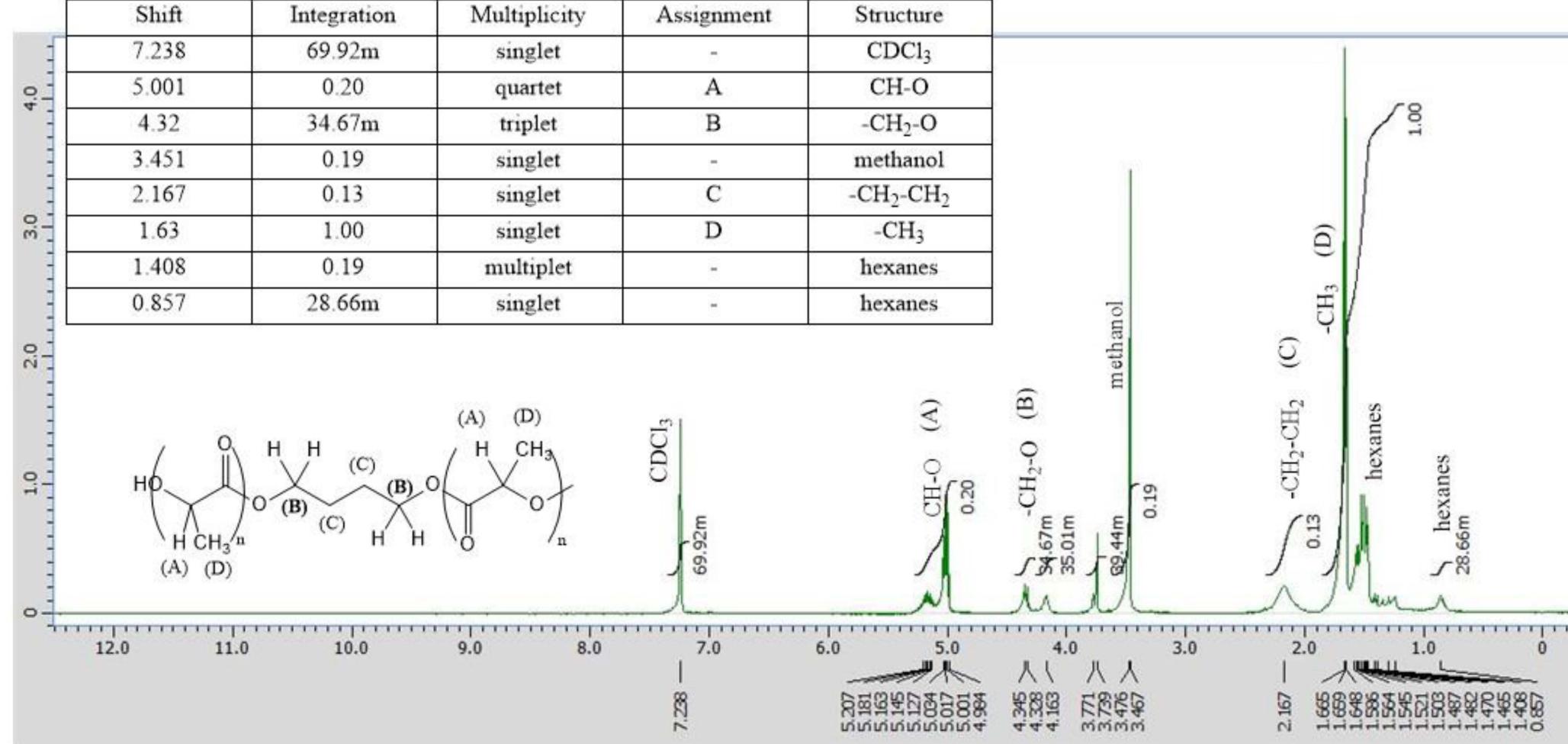
% Conversion: 50%





NMR Analysis

Shift	Integration	Multiplicity	Assignment	Structure
7.238	69.92m	singlet	-	CDCl ₃
5.001	0.20	quartet	A	CH-O
4.32	34.67m	triplet	B	-CH ₂ -O
3.451	0.19	singlet	-	methanol
2.167	0.13	singlet	C	-CH ₂ -CH ₂
1.63	1.00	singlet	D	-CH ₃
1.408	0.19	multiplet	-	hexanes
0.857	28.66m	singlet	-	hexanes



NMR Analysis

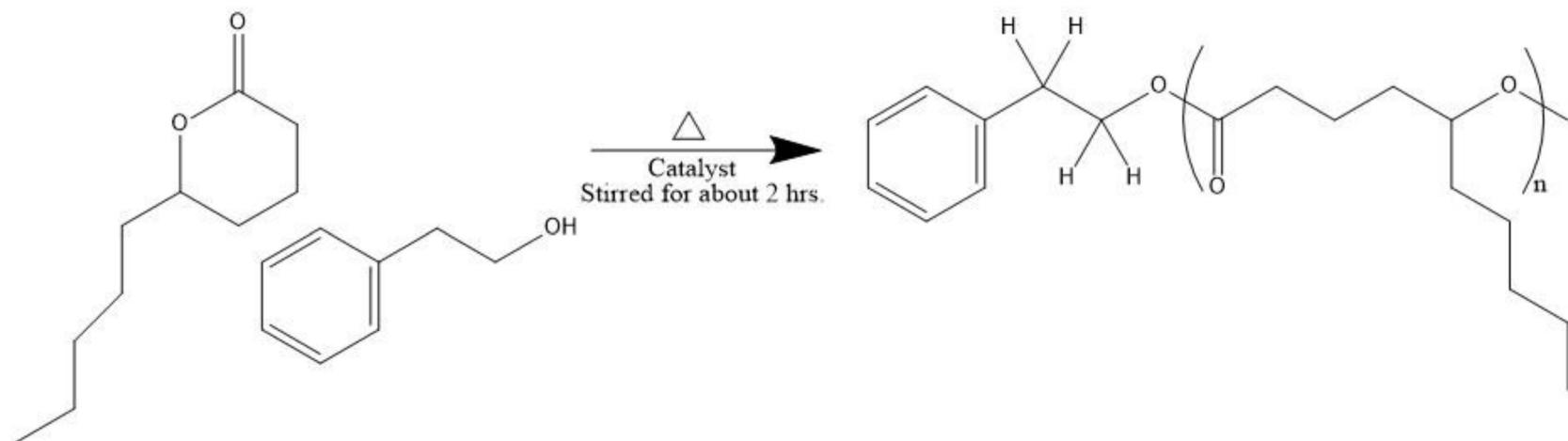
Delta-decalactone & 2-Phenylethanol

Feed Ratio: 40:1.0:0.5, 20:1.0:0.5

Time: 2hrs

DP: No DP

% Conversion: -



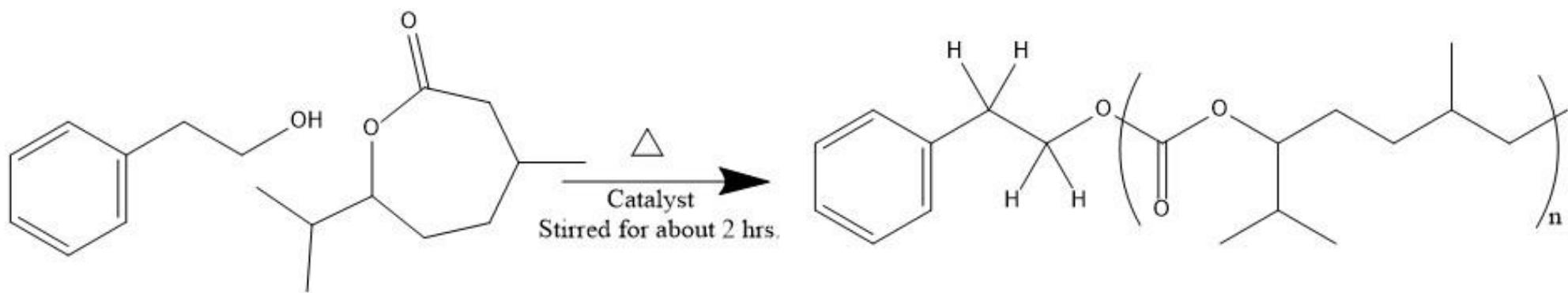
Menthide & 2-Phenylethanol

Feed Ratio: 20:1.0:0.5

Time: 2hrs

DP: 8.62

% Conversion: 78.8%



Conclusion

Degree of polymerization – chain length

- Different DP for each reaction
- Inconsistency
- No control

Stereochemistry

- Lactide may have a preference

Time

- Increasing time
- Monomers may have a preference

Catalyst

- Aluminum – slow, decomposed
- % Conversion is low

Future works

New catalysts

Increasing the time of the reaction

Purifying lactide to obtain a higher DP

- Subliming

Delta-decalactone

Menthide

Acknowledgements

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Lab Partner – Davis Deanovic

CSB/SJU Chemistry Department