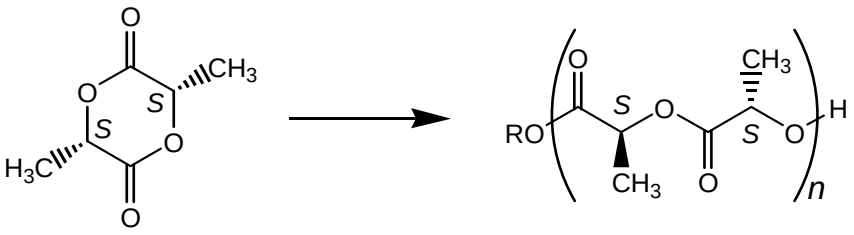
Chem/MatS/ChEn 4223W

Assignment 15
Due: *In Lab*, Tuesday, April 2/Thursday, April 4

This week you will be synthesizing polylactide (PLA), a polymer which has received a lot of recent press due to the fact that it can be made entirely from natural, renewable feedstock. NatureWorks LLC (http://www.natureworksllc.com/) is currently synthesizing PLA from corn at a facility in Blair, Nebraska. Like any polymer material, the uses of PLA are largely determined by the polymer's physical properties; you can read Cargill Dow scientists' review of these properties and uses in: Drumright, R. E.; Gruber, P. R.; Henton, D. E. "Polylactic Acid Technology." *Adv. Mater*. **2000**, *12*, 1841 (http://tinyurl.com/advmatpla). Like Cargill Dow, you will be synthesizing your polymer by tin-catalyzed ring-opening polymerization. (Info on the mechanism: Kricheldorf, H. R.; Kreiser-Saunders, I.; Boettcher, C. *Polymer* **1995**, *36*, 1253, http://tinyurl.com/tinplamech).



L-lactide poly(L-lactide)
PLLA

As this article points out, the properties and processing of PLA are intimately related to its stereochemical purity, i.e., the relative amounts of L- and D-lactic acid units (or *S* and *R* stereocenters) that are present in the polymer. This dependence of properties on stereoisomeric purity is the focus of Lab 6. In addition to polymerizing pure L-lactide to form isotactic PLLA, you will also be intentionally doping your natural L-lactide with "impurity", racemic lactide, according to the following chart:

Pair #	1	2	3	4	5	6	7	8
pure L-lactide	**2.94 g**	**2.64 g**	**2.88 g**	**2.52 g**	**2.82 g**	**2.25 g**	**2.76 g**	**1.95 g**
racemic lactide	**0.06 g**	**0.36 g**	**0.12 g**	**0.48 g**	**0.18 g**	**0.75 g**	**0.24 g**	**1.05 g**

Pair #	9	10	11	12	13	14	15	16
pure L-lactide	**2.97 g**	**2.70 g**	**2.91 g**	**2.58 g**	**2.85 g**	**2.40 g**	**2.79 g**	**2.10 g**
racemic lactide	**0.03 g**	**0.30 g**	**0.09 g**	**0.42 g**	**0.15 g**	**0.60 g**	**0.21 g**	**0.90 g**

The dark boxes in the chart show “supergroups” that will be sharing data and instrument time in this lab.

What amount of pure L-lactide did you use in your synthesis?

g

What amount of racemic lactide did you use?

g

Racemic lactide is 50% L-lactide, 50% D-lactide, and 0% *meso*-lactide. So, in your “impure” polymer, what is the total fraction of

L-lactide?

%

meso-lactide?

%

D-lactide?

%

And what does this mean for the fraction of *R* and *S* stereocenters in your group’s “impure” material?

% (*R*) centers?

%

% (*S*) centers?

%

What about in the material from the other members of your supergroup? In their “impure” polymer, what is the total fraction of

L-lactide?

%

meso-lactide?

%

D-lactide?

%

And what does this mean for the fraction of *R* and *S* stereocenters in their “impure” material?

% (*R*) centers?

%

% (*S*) centers?

%