

## CHAPTER V

### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Conclusions

This study was focused on the synthesis of poly(L-lactic acid) by ring-opening polymerization. The first step was L-lactide synthesis which was divided into 2 steps, i.e., production of molecular weight PLLA and formation L-lactide of ring by decomposition of low molecular weight PLLA. In this step, L-lactide crystal was obtained in 15.57% yield and the crystal was needle-like crystal with white color.

The second step was polymerization of PLLA using L-lactide as monomer. Stannous 2-ethylhexanoate ( $\text{Sn}(\text{Oct})_2$ ) and creatine hydrate were used to initiated L-lactide ring opening polymerization in coordination-insertion mechanism. Physical appearance of PLLA products were white powder. The first initiator,  $\text{Sn}(\text{Oct})_2$ , produced the highest yield (82.17% in Table 4.2) and molecular weight PLLA ( $\overline{M}_w = 11040$  in Table 4.2) at  $120^\circ\text{C}$ , 24 hours under nitrogen atmosphere. The second initiator, creatine hydrate, produced the highest yield (56.50% in Table 4.3) in polymerization time of 96 hours at  $120^\circ\text{C}$ . However, the suitable condition to produce the highest molecular weight ( $\overline{M}_w = 7005$  in Table 4.3) was  $140^\circ\text{C}$ , 96 hours.

This research found that the highest yield and molecular weight of PLLA was obtained by using  $\text{Sn}(\text{Oct})_2$  as an initiator. The creatine hydrate produced low yield and low molecular weight PLLA. If condition was too long reaction time and too high reaction temperature, the PLLA products will be decomposed, low yield and low molecular weight were obtained and color may be changed.

The next step was to increase molecular weight PLLA by using two types of chain extenders (HMDI and tolylene 2,4-diisocyanate terminated poly 1,4-butanediol prepolymer). This result indicated that the tolylene 2,4-diisocyanate terminated poly

1,4-butanediol prepolymer increased molecular weight PLLA more than HMDI. The suitable ratio between PLLA to tolylene 2,4-diisocyanate terminated poly 1,4-butanediol prepolymer which could increase molecular weight and gave good glass transition temperature ( $T_g = 45.1^\circ\text{C}$ ) was 1:1.1. In this research, the highest molecular weight range obtained was approximately 10,000-30,000.

## 5.2 Recommendations

1. To further increase molecular weight of PLLA using a mixture of chain extenders, those are:
  - Chain extender containing diisocyanate group.
  - Chain extender containing oxazoline group.

A parameter studied:

- Ratio of diisocyanate to oxazoline

The diisocyanate group could be reacted with  $-\text{OH}$  group of PLLA reactive chain end and the oxazoline group could be reacted with  $-\text{COOH}$  group of PLLA reactive chain end.

2. To investigate the glass transition temperature of PLLA at different ratio of diisocyanate to oxazoline.