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SYNTHESIS AND CHARACTERIZATION OF PLA-BASED ALIPHATIC- AROMATIC COPOLYESTERS: EFFECT OF DIOLS

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A Thesis Presented

by

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Master of Engineering in
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Aliphatic-Aromatic Copolyesters: Effect of Diols

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Abstract

PLA-based aliphatic aromatic copolyesters have been synthesized and characterized in order to incorporate the degradability of PLA and good mechanical property of aromatic species. Synthesis of the copolymer was conducted by polycondensation of lactic acid with dimethyl terephthalate (DMT) and diols using Stannous(II)octoate as a catalyst. Four types of diols with different methylene length were employed, i.e., ethylene glycol (EG), propylene glycol (PG), 1, 4-butanediol (BD), 1,3-propanediol (PD). Effects of diols and comonomer ratio on the polycondensation and the molecular weight of resulting copolymers were investigated. Diacids and diol ratios of L-lactic acid (LLA), dimethyl terephthalate (DMT) and diol of 1/1/2, 1/2/4, and 2/1/2 were employed, respectively. Characterization of chemical property, molecular weight, thermal property and degradability of the resulting copolymers were conducted by FTIR, UV, NMR, TGA, and DSC experiments.

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LA	lactic acid
DMT	dimethyl terephthalate
T	terephthalate
EG	ethylene glycol
EG212	synthesized copolymer with mol ratio 2/1/2 (LA/DMT/EG)
EG112	synthesized copolymer with mol ratio 1/1/2 (LA/DMT/EG)
EG124	synthesized copolymer with mol ratio 1/2/4 (LA/DMT/EG)
PG	propylene glycol
PG212	synthesized copolymer with mol ratio 2/1/2 (LA/DMT/PG)
PG112	synthesized copolymer with mol ratio 1/1/2 (LA/DMT/PG)
PG124	synthesized copolymer with mol ratio 1/2/4 (LA/DMT/PG)
PD	1,3-propane diol
PD212	synthesized copolymer with mol ratio 2/1/2 (LA/DMT/PD)
PD112	synthesized copolymer with mol ratio 1/1/2 (LA/DMT/PD)
PD124	synthesized copolymer with mol ratio 1/2/4 (LA/DMT/PD)
BD	1,4-butane diol
BD212	synthesized copolymer with mol ratio 2/1/2 (LA/DMT/BD)
BD112	synthesized copolymer with mol ratio 1/1/2 (LA/DMT/BD)
BD124	synthesized copolymer with mol ratio 1/2/4 (LA/DMT/BD)
PLA	polylactic acid
PET	Poly(ethylene terephthalate)
TPA	terephthalic acid
BHET	bis(hydroxyethyl) terephthalate
DP	degree of polymerization
MW	molecular weight
η	intrinsic viscosity
Tg	glass transition temperature
Tm	melting temperature
HMDI	hexamathylene diisocyanate
BDI	1,4-butane diisocyanate
IPDI	isophorone diisocyanate
MDI	diphenylmethane diisocyanate
BOX	2,2'-bis(2-oxazoline)
DSC	Differential Scanning Calorimetry
TGA	Thermo Gravimetric Analysis
FTIR	Fourier-Transform Infrared
NMR	Nuclear Magnetic Resonance
$CDCl_3$	deuterochloroform
B	degree of randomness
$L_{n(L)}$	the number-average sequence lengths of L
$L_{n(ET)}$	the number-average sequence lengths of ET
$Y_{(L)}$	probability of finding L next to another L
$X_{(ET)}$	probability of finding ET next to another ET
CH_2Cl_2	dichloromethane
THF	tetrahydrofuran