

Title	微生物由来フェニル乳酸誘導体からのバイオベースポリエステルの合成と物性評価
Author(s)	Nguyen, Hieu Duc
Citation	
Issue Date	2015-09
Type	Thesis or Dissertation
Text version	ETD
URL	<a href="http://hdl.handle.net/10119/12974">http://hdl.handle.net/10119/12974</a>
Rights	
Description	Supervisor:金子 達雄, マテリアルサイエンス研究科, 博士

## Abstract for PhD Dissertation

Hieu Duc Nguyen, 2015

School of Materials Science, Japan Advanced Institute of Science and Technology

Suitable syntheses to apply bio-based compounds in producing polymer are earnestly desired in the field of bio-related materials. Microbial lactate derivatives phenylactic acids PhLAs and D-hydroxyphenylactic acid were used to synthesize bio-based polymers with various architecture and properties.

In chapter 2, optimization of a direct melt polycondensation in the presence of stable Lewis acids such as  $\text{HfCl}_4 \cdot 2\text{THF}$  resulted in poly(phenylactic acid)s (PLPhLAs) with high molecular weight. As a result, the homo poly(L-phenylactic acid), PLPhLA, with a number-average molecular weight ( $M_n$ ) more than  $100,000 \text{ g}\cdot\text{mol}^{-1}$  were obtained and showed specific optical rotation  $\alpha_D^{25}$  of  $46^\circ$  and the glass-transition temperature ( $T_g$ ) of  $55^\circ\text{C}$  whose absolute values were higher than the reported values and was comparable with  $T_g$  of chiral-homopolyester poly(L-lactic acid). The properties of resulted PPhLAs were characterized in relation with their structure by nuclear magnetic resonance analyses.

In chapter 3, melt polycondensation reaction with tin metal catalyst under reduced pressure for branched polyester from DHPA and glycolic acid. The copolyester of DHPA with glycolic acid resulted in significantly high  $T_g$  polyesters of maximum  $110^\circ\text{C}$ . By spectroscopy study, we found that high  $T_g$  value of copolyester should be the result of hyperbranching property supported by trifunctional structure of DHPA as well as the addition of DHPA benzene ring into the branched polymer structure. Branching process of polymer is observed through gel-permeation chromatograph and nuclear magnetic resonance analyses showed the role of DHPA as branching generating point at each course of polymerization time. Thermal properties of branched polymer were records in relation with branching degree and architecture development of polymer chain.

In chapter 4, the trifunctional characteristic of DHPA is modified with the aim to increase thermostability of bio-based polylactate derivatives. I used modified microbial D-hydroxyphenylactic acid (DHPA) as a monomer to produced polyester having benzene ring in its backbone. Several surveys of polymerization of DHPA's precursor were conducted with aliphatic and aromatic diacyl chloride. Firstly a reactivity of methylated DHPA in polycondensation with a series of aliphatic diacid chloride was confirmed to give semi-aromatic polymers. Next I prepared thermally-stable DHPA-based Polymers by polycondensation with aromatic diacylchlorides such as terephthaloyl chloride and isophthaloyl chloride. As a consequence, the polylactate derivatives showing a glass-transition temperature ( $T_g$ ) as high as  $130^\circ\text{C}$  without any additives was synthesized.

**Keyword:** bio-based polymer, lactate derivatives, glass-transition temperature, polymer architecture, polymer synthesis.