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学 位 （ 博 士 ） 論 文 要 旨
(Doctoral thesis abstract)

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主指導教員 氏 名 Chief Advisor's Name	荻野 賢司	副指導教員 氏 名 Vice Advisor's Name		副指導教員 氏 名 Vice Advisor's Name	
論文題目 Title	Development of Novel Environmentally-Friendly Bio-based Polymers Derived from Natural Cardanol				

論文要旨（和文要旨(2000 字程度)または英文要旨(500words)）
※欧文・和文どちらでもよい。但し、和文の場合は英訳を付すこと。
Write a summary in Japanese (2000 characters) or in English (500words).
If the abstract is written in Japanese, needed to translate into English.

Recently, worldwide environmental problems such as global warming, depletion of fossil resources, plastic pollution have been solved to establish sustainable economy. Development of chemicals and polymers from renewable resources has received great attention to mitigate these environmental concerns. The use of biomass resources is highly significant for the reduction in greenhouse gases as well as saving fossil resources. Particularly, utilization technology of non-edible biomass resources has received much attention since these resources are not competitive as food. Among agricultural biomass resources, plant oil is one of the candidates for the feedstocks of bio-based materials, since plant oils have various nature such as abundant renewable resources, cost effectiveness, availability of chemical reaction, etc. CNSL is obtained from cashew nuts shells which are biomass waste in cashew nuts industry. This plant oil possesses very unique properties such as phenolic compound having long alkyl side chain, antimicrobial property, antioxidant property, and UV absorption property, etc.
Here, effective utilization technology of CNSL was investigated to develop novel functional bio-based polymer.

In Chapter 1, introduction of this thesis is described. Research background and literature review of recent CNSL work are summarized in this chapter.

In Chapter 2, novel bio-based epoxy polymer was developed. The epoxy polymers were prepared from all cardanol-based epoxy and amine components at room temperature without any organic solvent. Molecular weight of epoxy cardanol prepolymer and thermal treatment improved the drying thermal and mechanical properties. Therefore, environmentally-friendly preparation protocols without formaldehyde, heavy metal catalyst, and organic solvent for novel all cardanol-based epoxy polymers was developed.

In Chapter 3, novel bio-based epoxy composite was developed. The epoxy composites were prepared from all cardanol-based epoxy and amine components with cellulose nanofiber (CNF). Pretreatment of CNF immobilization with amine components provided better improvement of thermal and mechanical

properties of the composites. This result indicated that hydrophobic CNF can be reacted with phenalkamine to give the CNF immobilization with phenalkamine and worked effectively as reinforced materials in cardanol-based epoxy polymer.

In Chapter 4, novel bio-based photocurable polymer was developed. The polymer was prepared from allyl cardanol and thiol compound via thiol-ene photoclick reaction at room temperature without any organic solvent. The resultant UV-cured polymers showed flexible transparent self-standing nature, thermal stability, and long-term stability (i.e., anti-aging) as compared with other cardanol-based polymers. This is because that thiol-ene reaction proceeded effectively among S-H and C=C, leading to be more highly crosslinked structure. Furthermore, thermal treatment of UV-cured polymers improved aging behavior because S-S bonds were formed between unreacted S-H groups after thermal treatment.

In chapter 5, Conclusion of this thesis is described. The strategy for the utilization of CNSL investigated in this thesis provides various fundamental research benefits in academia and industry. The significance of this research is believed to broaden the utilization of CNSL for novel bio-based polymer synthesis and their applications for sustainable economy to mitigate recent global environmental problems.

（英訳）※和文要旨の場合(300 words)
If the abstract is written in Japanese, needed to translate into English.(300 words)