学　位　論　文　審　査　の　要　旨

Doctoral Thesis Evaluation Summary

博士の専攻分野の名称　博士（理 学）　　氏　名　　孫　桃林

Degree requested　Doctor of Science　Name: Tao Lin SUN

審査担当者 Examiners	主査 Chief examiner	教　授	龔　剣萍
	副査 Associate examiner	教　授	佐々木　直樹
	副査 Associate examiner	准教授	黒川　孝幸（生命科学院）

学　位　論　文　題　名

Title of Doctoral Thesis

Synthesis of Novel Hydrogels from Linear Polyampholytes and Analysis of Their High Toughness and Viscoelasticity

(線形両性電解質高分子による新規ハイドロゲルの合成とその高靭性と粘弾性機能の解析)

Hydrogels attract great attention as biomaterials as a result of their soft and wet nature, similar to that of biological tissues. Recent inventions of several tough hydrogels show their potential as structural biomaterials, such as cartilage. Any given application, however, requires a combination of mechanical properties including stiffness, strength, toughness, damping, fatigue resistance and self-healing, along with biocompatibility. This combination is rarely realized.

This study reports for the first time that polyampholytes, polymers bearing randomly dispersed cationic and anionic repeat groups, form tough and viscoelastic hydrogels with multiple mechanical properties. These physical hydrogels are synthesized by random copolymerization of oppositely charged ionic monomers around the charge balance point at high concentration. The randomness makes ionic bonds of a wide distribution of strength. The strong bonds serve as permanent crosslinks, imparting elasticity, whereas the weak bonds reversibly break and re-form, dissipating energy. These physical hydrogels of supramolecular structure can be tuned to change multiple mechanical properties over wide ranges by using diverse ionic combinations. This polyampholyte approach is synthetically simple and dramatically increases the choice of tough hydrogels for applications. As the materials have the wide spectrum of excellent mechanical properties even in physiological solutions, they have high potential as structural biomaterials, for example, as artificial cartilages with high fatigue resistance, and shock-absorbing mouth guard for sports players. In addition, they are non-toxic and anti-fouling to cell adhesion, suggesting the potential use in hygiene and medical fields, for example, as contamination-free surgical gloves, blood bags, syringes, contraceptives, and implantable devices.

In conclusion, the author has developed a new class of tough hydrogels from linear polyampholytes, and discovery of these novel polyampholyte hydrogels makes a large contribution to polymer materials science. Therefore, we acknowledge that the author is qualified to be granted the doctorate of Science from Hokkaido University.