Doctoral Dissertation Evaluation Review

Degree requested Doctor of Life Science Applicant's name Guo Yunzhou

Examiner:

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Title of Doctoral Dissertation

Study on facile fabrication of super strong cellulose hydrogel
with anisotropic hierarchical fibrous structure
（異方的階層繊維構造を持つ超高強度セルロースハイドロゲルの簡便な製造に関する研究）

Results of Evaluation of the Doctoral Dissertation (Report)

Recently, the studies on preparation of super strong hydrogels for biological applications are being actively done. Most of the researches focus on building the molecular network structure through cross-linking different polymers or nanocomposites. Improvement on the strength of man-made hydrogels has been made over past years. However, the strength comparable to human connective tissues is still far from reaching.

In this study, based on the previous research on preparation of alginate hydrogel with hierarchical and highly aligned fibrous structure, the author performed research on preparation of super strong cellulose hydrogel with biomimetic fibrous structure, using a facile method, called Drying in Confined Condition method (DCC method), aiming at acquiring of beneficial structure and mechanical performance.

The DCC method greatly improved the mechanical property of all cellulose hydrogels, and by applying DCC method on cellulose alcogel, with 50% prestretching (DCC-E50%), the extreme mechanical property at human Achilles tendon level was successfully acquired. Such strength has rarely been reported in hydrogel's area.

Careful examination on the mechanical property of DCC cellulose hydrogels has also been done, DCC-E hydrogels show enhanced strength while maintained high toughness.

The author tried different structural characterization methods to check the hierarchical fibrous structure for better understanding the relation between the structure and mechanical property. Highly aligned structure at different scales and different ways of fibrils aggregation were confirmed. The alignment and aggregation of fibrils induced by DCC method were considered to be the central role in both enhancement and toughening.

In conclusion, the author has new findings and understanding on fabrication of super strong biopolymer hydrogels, and these will contribute to the development of novel biological materials for practical applications in emerging areas such as tissue engineering and soft robotic.

Therefore, we acknowledge that the applicant is qualified to be granted a Doctorate of Life Science from Hokkaido University.