【Grant-in-Aid for Scientific Research (S)】

Biological Sciences (Agricultural sciences)

Title of Project : Preparation of Completely Individualized Nanofibrils from Biomass, and Their Conversions to Environmentally Compatible Materials

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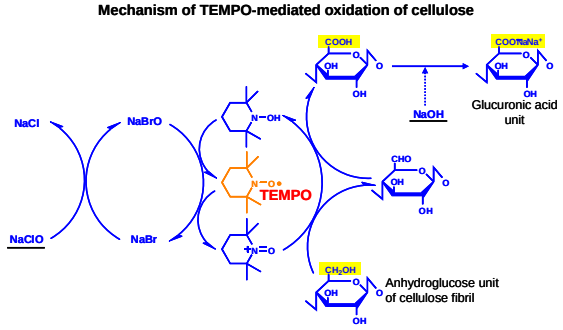
Research Area : Agriculture

Keyword : biomass, cellulose, chitin, nanofibril, TEMPO-mediated oxidation

【Purpose and Background of the Research】

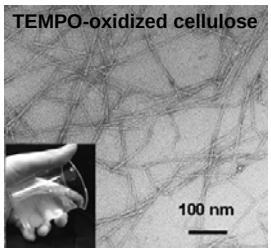
We have developed new bio-nanofibrils 3-10 nm in width and at least a few microns in length from cellulose and chitin by TEMPO-mediated oxidation and its related electrostatic interactions between bio-fibrils.



The above principles will be applied to other structural polysaccharides, fibroin and other crystalline biomass to prepare completely individualized nanofibrils dispersed in water. Relationships between the nanofibrils preparation conditions and the nano-structures or properties will be investigated in detail to apply the bio-nanofibrils to environmentally compatible and high-tech materials Based on the obtained results, fundamental and wide-scope information concerning nanofibrils will be accumulated to establish new bio-nanotechnology research field.

【Research Methods】

Various celluloses, chitins and fibroins are oxidized by TEMPO-mediated system under neutral-weakly acid conditions, and chemical structures of the oxidized products are analyzed in terms of the oxidation conditions. Bio-nanofibrils are prepared by mild disintegration of the oxidized products in water, and their nano-scale structures are investigated by TEM, SPM and other analytical methods. Biodegradation mechanisms of the TEMPO-oxidized products and related enzymes are also studied to establish switch functions for biodegradation. Hybrid materials between the TEMPO-oxidized bio-nanofibrils and biomaterials such as PLA, PHB, cellulose acetate and others are prepared, and their characteristics such as mechanical strength, transparency, gas-permeability, thermal stability, water-repellency and water- or oil-penetration properties are investigated. The TEMPO- mediated oxidation will be applied also to fundamental research fields of biomaterials to elucidate their solid-state structures and biosynthesis mechanisms.



【Expected Research Achievements and Scientific Significance】

Individualized bio-nanofibrils prepared from biomass by TEMPO-mediated oxidization or related electrostatic interactions are new bio-based materials with various potential applications. During the development research of applying new bio-nanofibrils to environ-mentally compatible and high performance components, we challenge for creation and establishment of sustainable society.

【Publications Relevant to the Project】

・Saito, T., Kimura, S., Nishiyama, Y., Isogai, A., "Cellulose nanofibers prepared by TEMPO-mediated oxidation of native cellulose", *Biomacromolecules*, **8**, 2485-2491 (2007)

・Fukuzumi, H., Saito, T., Kumamoto, Y., Iwata, T., Isogai, A., "Transparent and high gas barrier films of cellulose nanofibers prepared by TEMPO-mediated oxidation", *Biomacromolecules*, **10**, 162-165 (2009).

【Term of Project】 FY2009-2013

【Budget Allocation】 151,500 Thousand Yen

【Homepage Address and Other Contact Information】

http://psl.fp.a.u-tokyo.ac.jp/hp/

http://psl.fp.a.u-tokyo.ac.jp/hp/isogai/IsogaiJ.htm