【Grant-in-Aid for Young Scientists (S)】

Biological Sciences (Agricultural sciences)

Title of Project: Functional Architectonics of Glyco-Biomaterials Designed via Cellulosic Nano-Assemblers

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Research Area : Agricultural sciences

Keyword : Cellulose

【Purpose and Background of the Research】

The research and developments of bio-functional materials have recently been promoted by a synergy of biotechnology and nano-engineering. Sugar-mediated interactions with living cells have attracted much attention in biomedical engineering fields. Therefore, novel glyco-materials with regulated sugar conformations as well as densities are required in the related research frontiers.

Cellulose, a β-1,4-linked D-glucopyranose biopolymer, is the major constituent of plant cell walls. It shows unique self-assembling properties due to the regular formation of intra- and intermolecular hydrogen bonds. Parallel chain alignment of native crystalline cellulose is regarded as clustering of non-reducing end groups of functional sugars.

The aim of this research project is the functional design of biomimetic glyco-materials. A new concept of nano-architectonics will be advanced by using "synthesized" cellulose as a nano-assembler of functional sugars. We are going to establish the fundamental research of structural and functional units contained in the glyco-materials, designed via cellulosic nano-assemblers.

【Research Methods】

Our objective is the development of novel glyco-interfaces and nanoparticles with nano-structured functional sugars. For the synthesis, a combination of the following three techniques, established in our laboratory, is going to be applied:

(1) Nonaqueous enzymatic glyco-synthesis
(2) Vectorial glyco-chain immobilization
(3) In-situ glyco-conjugation with AuNPs

Surface-protected enzymes are used to synthesize hetero-oligomers containing cellulose-units and bio-functional sugars which are further derivatized with an S-anchor. The designed oligo-sugars form nanolayers through self-assembling S-Au chemisorption on gold surfaces, resulting in the functional development of nano-structured glyco-biomaterials.

【Expected Research Achievements and Scientific Significance】

Essential sugar-mediated interactions closely associated with living systems have become the focus of research and developments of advanced glyco-materials. This research project provides nano-architectural design approaches based on non-aqueous biocatalysis and vectorial sugar-chain conjugation for adapted bio-interfaces and nano-particles with regard to cell-culture and biosensor studies. Additional information on the interactive phenomena at the glyco-/bio-interfaces can be applied to design biomaterials. Cellulose-assisted clustering of defined carbohydrates that directly interact with living cells are going to allow us to achieve further bio-manipulation and to break into a new phase in glyco-material engineering fields.

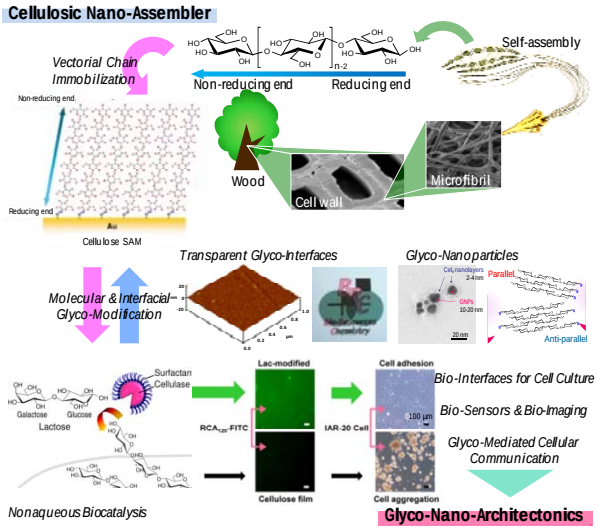

Figure Architectural design of glyco-biomaterials

【Publications Relevant to the Project】

- Egusa S., Kitaoka T., Goto M., Wariishi H., "Synthesis of cellulose in vitro by using a cellulase/surfactant complex in a nonaqueous medium", *Angew. Chem. Int. Ed.*, **46**, 2063-2065 (2007).
- Yokota S., Kitaoka T., Opietnik M., Rosenau T., Wariishi H., "Synthesis of gold nanoparticles for in situ conjugation with structural carbohydrates", *Angew. Chem. Int. Ed.*, **47**, 9866-9869 (2008).

【Term of Project】 FY2009-2013

【Budget Allocation】 77,100 Thousand Yen

【Homepage Address and Other Contact Information】

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