

Project Title: Creation of Innovative Biotechnology Based on Membranome**Name:** Hiroshi UMAKOSHI**Institution:** Osaka University**1. Background of research**

There are some drawbacks, such as low stability and short life time of the biomolecules (i.e. nucleotide and enzyme), in conventional biotechnology based on “Genome” and “Proteome” when one would consider its industrial applications. “Biomembrane”, such as photosynthetic membrane, is known to achieve the production and energy with high efficiency because it can assemble and integrate several biomolecules on the surface of phospholipid membrane. However, there is no example on its application.

2. Research objectives

“Liposome (Model Biomembrane)” could be regarded as “Soap Bubble” existing in “Water”. It has a “Hydrophobic (Lipophilic or Oily)” membrane with “nano”-meter and can function as a stage to achieve “Emergence” of useful structures for material production, such as “molecular recognition site” and “catalytic center”. These kinds of “potential” aspects of liposome can herewith be defined as “Membranome”. We will challenge to create an innovative biotechnology to perform the production of materials with a minimal energy input by utilizing the “*on membrane*” network of well-organized unit-recognitions and unit-reactions.

3. Research characteristics (incl. originality and creativity)

We have already reported original techniques, such as design and development of artificial enzyme liposome (LIPOzyme), and also established the liposome-based sensor (Membrane Chip) the liposome-based materials (membrane module and hydrogel) for the future industrial applications. A simple “Green Process”(i.e. production of medicine or antibody) with high efficiency and high stability could be developed through the further “tuning-up” of the LIPOzyme catalysis.

4. Anticipated effects and future applications of research

Through the “order-made design” of liposome membrane, there are some possible applications, (a) nano-chemical factory, (b) tissue-activating materials and future artificial organ. (c) bioremediation materials (recovery of rare metals) and so on. In contrast to the conventional chemical/ bio- process, one could develop new type of processes with less impact to the “(life)environment” and could regard it as a new technology to achieve the innovation of a modern society.

● Basic Concept

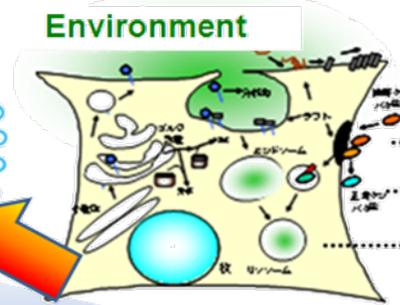


Chemical / Bio Process

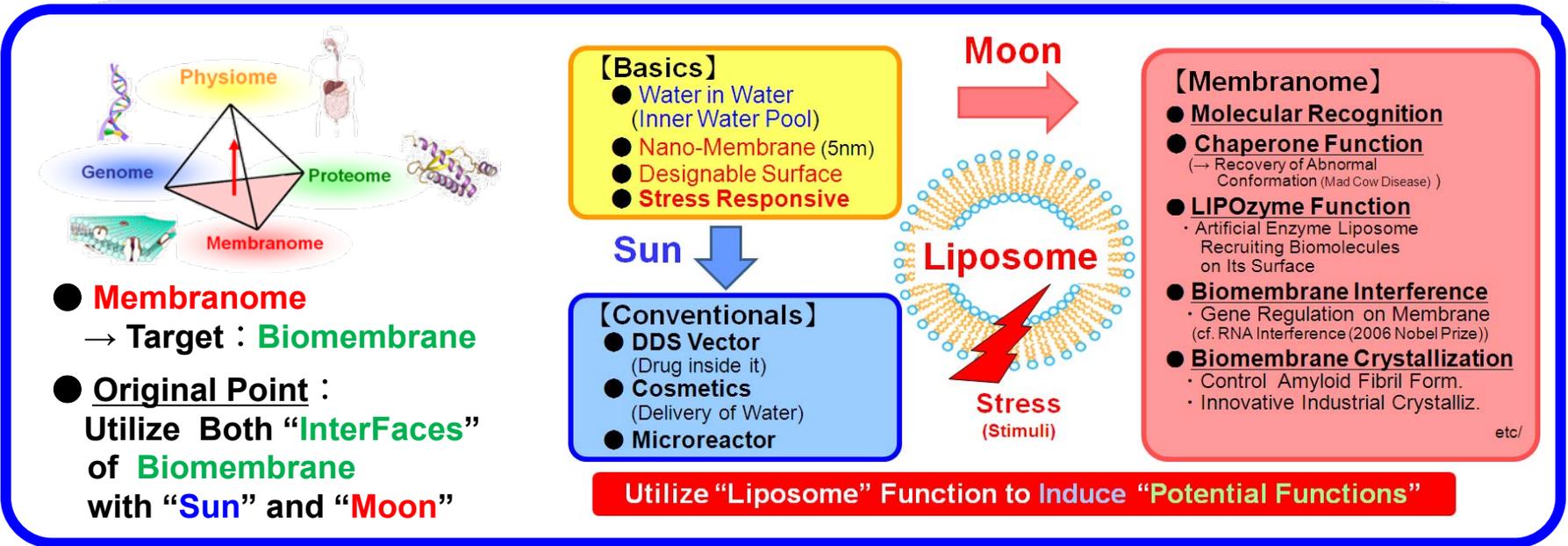
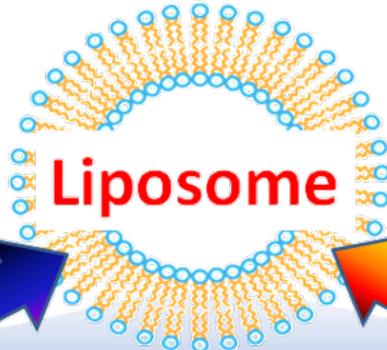


- **Multi-Unit Operation**
- **Impact : High (Consume)**

Life Process

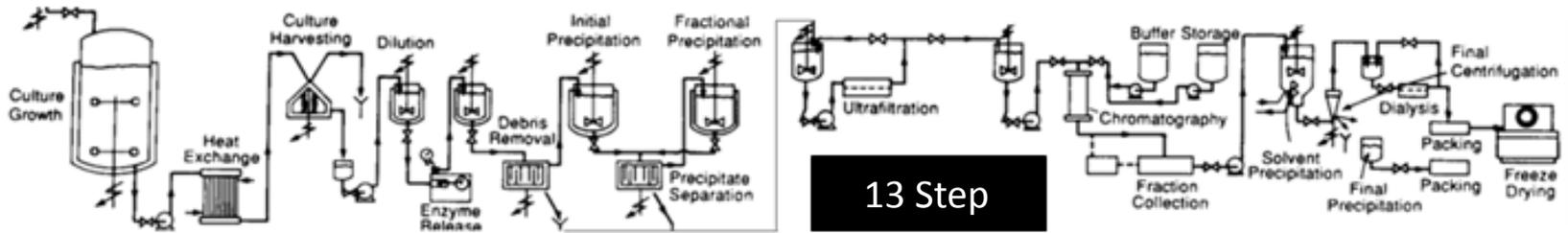


- **Simple / Well-Organized**
- **Impact : Minimal (Recycle)**



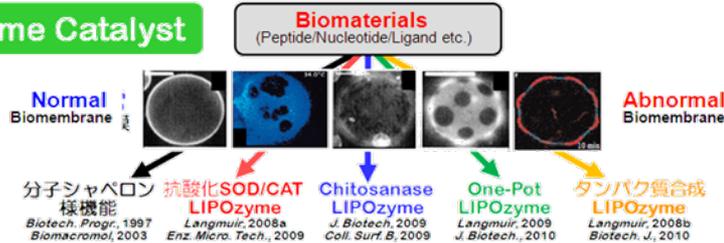
● Target: Process from “Multi” to “Simple”

【Conventional Process】 Multi-Steps: Energy/Material Consuming !



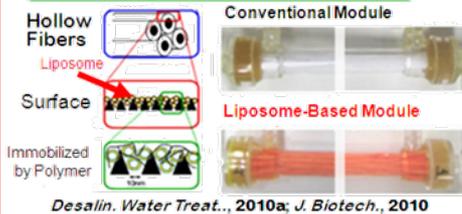
【LIPOzyme Based Process】 Simple !

LIPOzyme Catalyst

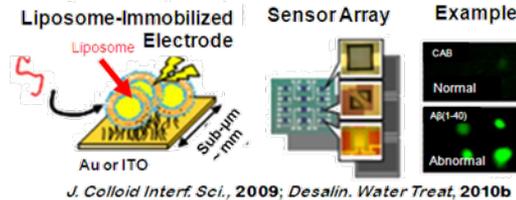


Induction of Potential (LIPOzyme) Function via “Design”

LIPOzyme Module

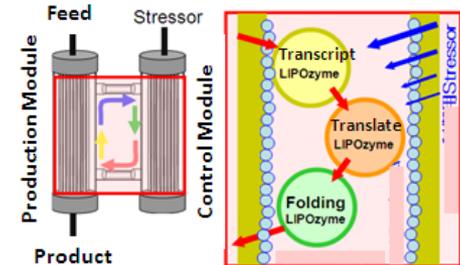


Membrane Chip



Original Membranomics Tool !

LIPOzyme-Module Based Process



Integrate Recognitions Reactions on Membrane

LIPOzyme Sheet Based Process

