Artificial Cell Models Exhibiting Self-reproducing and Self-replication Dynamics and Spontaneous Movements

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1. INTRODUCTION
In order to answer such profound questions as “From where has a life come?” “Where is a boundary between animate and inanimate objects?” a constructive approach is effective. We have constructed minimal cell models using well-defined organic molecules and bio-polymers and studied the non-linear dynamics. It turns out that some of them exhibit self-reproducing, self-replicating, and others dynamics show spontaneous movement, respectively.

2. SELF-REPRODUCING SYSTEM COMPOSED OF GIANT VESICLES
We have observed following self-reproducing dynamics exhibited by giant vesicles (GVs). [1] i) When a bolaamphiphilic membrane-precursor is added to giant vesicles containing a catalyst, ii) The membrane precursor is hydrolyzed to give same membrane molecule as the original GVs, iii) Increase of the membrane molecules causes corpulence of GVs, iv) As a result, corpulent GVs self-divide into two GVs with the same composition. When the self-reproducing dynamics was traced by flow cytometry, we found that the self-reproducing continues through several generations, keeping the similar size-distribution of the original. [2]

3. SELF-REPLICATION OF INFORMATIONAL MOLECULES INSIDE GIANT VESICLES
We conducted polymerase chain reaction (PCR) of DNA using a template DNA consisted of ca. 1200 base pairs and confirmed self-replication by SYBR Green I (fluorescent probe that emits green light when hybridized with duplicated DNA) and polyacrylamide gel electrophoresis. [3] Complementary self-replication of a template was also carried out on the surface of the outmost membrane of GV using a conjugate molecule made of a cholesterol-spacer-DNA 15mer. [4]

4. SELF-REWINDING HELIX AND SPONTANEOUSLY PROPELLING OIL DROPLET MADE OF SOFT MATTER
Another characteristic feature of a cell is “movement”. Such movement is driven by chemical energy acquired by hydrolysis of ATP. We found self-winding helix [5] and self-propelling oil droplet [6] made of soft matter by chance. It would be “soft matter” that connects animate and inanimate objects.

REFERENCES