CHEMISTRY SEMINAR

♧ **Speaker : Prof. Kwanwoo Shin(*Sogang University)***

♧ **Date : 2018. 09. 06 (Thu), 4:00 PM** ♧ **Place : Chem. Bldg. 400**

Challenges and Perspectives for Building a Man-made Synthetic Cells : Photosynthetic Artificial Organelles inside Liposomal Minimal Cell

Due to the extreme complexity of a living cell, the notion of mimicking cell minimally includes; (1) construction of cellular membranes, providing cellular space and functionalities at interfaces; (2) chemical and biological reactions in cellular structures and (3) construction of a cytoplasmic environment (including macromolecular crowding and compartmentalization of biomolecular components). In nature, photosynthesis provides that energy gradient across lipid membranes though transmembrane proteins, whereby the light energy is converted to chemical energy, to generate energy for incorporation of carbon dioxide. We designed, built, and tested a light-harvesting encapsulated organelle system that provides both a sustainable energy source and a means of controlling intracellular reactions. In these artificial organelles, an adenosine triphosphate (ATP) synthase and two photoconverters (plant-derived photosystem II [PSII] and bacteria-derived proteorhodopsin [PR]) enabled orchestration of ATP synthesis. Independent activation of the two photoconverters, which respond to different light wavelengths, allowed dynamic regulation of ATP synthesis: red light facilitated and green light impeded ATP synthesis.[1] Recently we applied the artificial organelles to simul ate a ubiquitous process in cells—cytoskeleton formation through ATP-dependent actin p olymerization. We embedded magnesium ionophores in a giant vesicle and encapsulated the organelles and the reactants (ADP and G-actin) within it to form the photosynthetic protocellular system. Optical stimulation initiated ATP synthesis and induced ATP-depen dent actin polymerization, leading to growth of three-dimensional actin filaments (Fig. 1). Red light facilitated and green light impeded filament growth via independent PSII and PR activation. The resulting system was able to induce and control cascading meta bolic reactions as well as exhibit cell-like behaviour. We envision that our bottom-up ap proach could be used to create isolated modules representing additional organelles. Intro ducing networks of proteins and organelles into artificial cell-like environments may con tribute to achieving *the long-standing goal of building a cell de novo*.

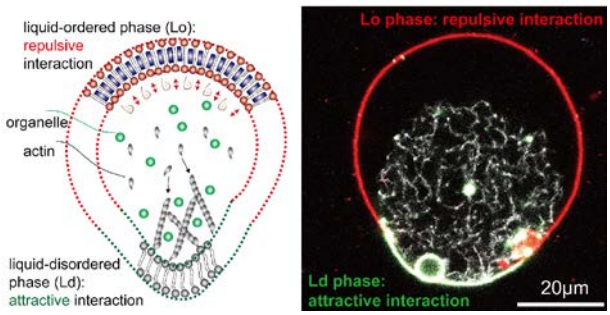

Fig. 1: Control of actin polymerization of the photosynthetic protocellular system by light in a giant vesicle; scheme (right), and confocal image (right).

DISCUSSION & CONCLUSIONS:

[1]K. Y. Lee, S-J. Park, K. A. Lee, S-H Kim, H. Kim, Y. Meroz, L. Mahadevan, K-H. Jung, T. K. Ahn, K. K. Parker, and K. Shin, ***Nat. Biotech***, 36, 530 (2018) (Selected as a Cover Paper)

Host : Kimoon Kim.