“Bio-adhesive” Covalent Organic Framework for Bioapplications

(*Graduate School of Engineering, The University of Tokyo*)
○Hyuna Jo, Kou Okuro, Takuzo Aida

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Biological channels are molecular gatekeepers that regulate substance transport across cell membranes in response to external stimuli. An intriguing example is a channelrhodopsin-1, an ion channel that opens in response to light, allowing proton transport.[1] Inspired by such biological channels, a variety of photoresponsive synthetic channels have been developed.[2,3] However, the synthetic channels are applicable for limited types of substances such as H^+ and K^+.

Herein, we newly designed a bio-adhesive covalent organic framework (^{Glue}COF) bearing multiple guanidinium ion (Gu^+) pendants. In the nanopores of ^{Glue}COF, we loaded rose bengal (RB), which generates singlet oxygen ($^1O_2$) upon photoirradiation,[4] as a photo-responsive pore-opener (^{Glue}COF⊃RB, Fig 1a). The multiple Gu^+ pendants serve as “molecular glue” to noncovalently adhere to the surface of liposomes via multivalent salt-bridge interactions (Fig 1a).[5] Photo-triggered transfer of a guest fluorescent dye (calcein) between liposomes was achieved (Fig 1b and c). In this presentation, the details of molecular design, substance transfer, and future perspective will be discussed.

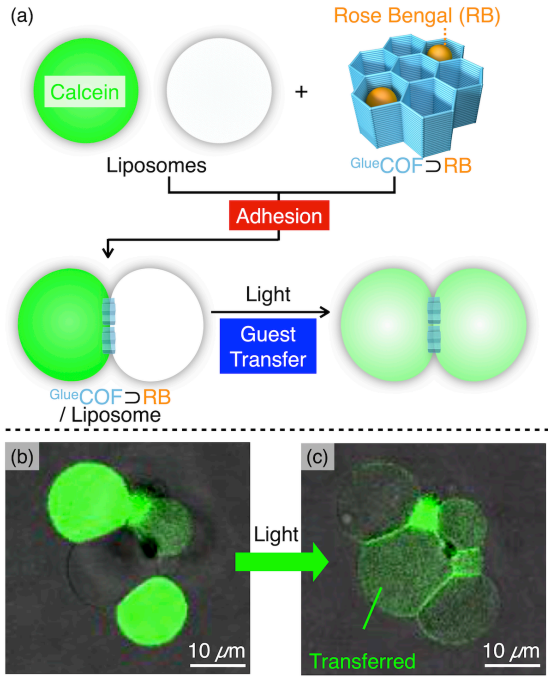

Fig 1. (a) Schematic illustration of guest transfer mediated by ^{Glue}COF⊃RB upon photoirradiation. (b, c) Confocal laser scanning microscopy (λ_{ex} = 488 nm) images of a mixture of calcein-loaded liposomes and guest-free liposomes with ^{Glue}COF⊃RB (b) before and (c) after photoirradiation.

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