Surface coating of an algal cell with long DNA strands elongated by a DNA polymerase for functionalization

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Microorganisms have been utilized as excellent conversion systems to produce valuable products for human beings. To date, cell engineering have partially developed such desirable species. However, it requires time-consuming and labor-intensive processes. On the other hand, artificial materials that show various bioactive characters have been exploited by biomimetic chemistry. By modifying natural cells with artificial materials, "functionalized cells" can be generated, which are complemented the lack of transformability and endowed with extended functions. In this project, as a model cell, a unicellular biflagellated alga, Chlamydomonas reinhardtii (CR), is modified with a DNA primer, which is conjugated with a polypeptide of 4-hydroxyproline (HYP) that binds tightly to the CR cell wall to immobilize it on the surface[1,2]. The immobilized DNA primers were then elongated with DNA polymerases to cover the CR cells with long DNA chains for further functionalization. This methodology opens a new avenue to readily and strikingly transform the cellular functions for various applications.

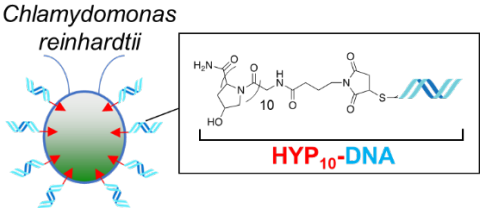

Figure 1. Modification of CR cell surface with HYP_{10}-conjugated DNA primer.

Firstly, to immobilize DNA primer on CR cell surface through a HYP polypeptide, a DNA-conjugated 10-mer HYP (HYP_{10}) was prepared. After purification, the product was mixed with CR cell to acquire the DNA primer-immobilized CR cells. (Figure 1). By adding DNA polymerase Klenow fragment exo (-) (KF-) and incubating the CR cell at 28°C for 2h, long double-stranded DNA chains with repeating sequence were elongated by slippage amplification[3] from CR cell surface (Figure 2). In the presentation, further modification of the elongated DNA layer with cationic lipids and gold nanoparticles through electrostatic interaction will be discussed.

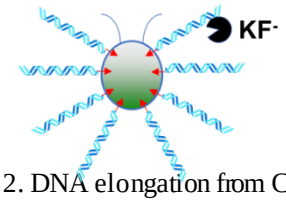

Figure 2. DNA elongation from CR cell surface with DNA polymerase.

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