Microfluidics for photoenzymatic CO2 conversion using solar energy

Artificial photosynthesis (APS) mimics natural photosynthesis (NPS) to store solar energy into chemical compounds for the applications such as water splitting, CO_2 fixation and coenzyme regeneration. In fact, the NPS is naturally an optofluidic system since the cells (typical size 10 to 100 μm) of green plants, algae, and cyanobacteria enable light capture, biochemical and enzymatic reactions and the related material transports in a microscale, aqueous environment. Long history of evolution has equipped the NPS with the remarkable merits such as large surface-area-to-volume ratio, fast diffusion of small molecule and precise control of mass transfer. The APS is expected to enjoy the same merits of NPS and even provides more functionalities if optofluidics technology is introduced. Recently, many studies have been reported on optofluidic APS systems, but it is still lack of an in-depth review. This article will start with a brief introduction of physical mechanisms, and will then review recent progresses in water splitting, CO_2 fixation and coenzyme regeneration, followed by the discussions of pending problems for real applications. There is still a large room for further improvement of the optofluidics-based artificial photosynthesis.

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