

ENZYME ASSEMBLY AND CATALYTIC ACTIVITY IN A REUSABLE BIOMEMS PLATFORM FOR METABOLIC ENGINEERING

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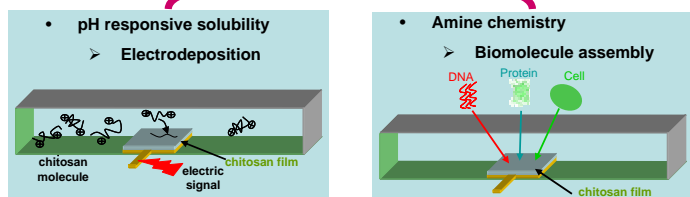
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Abstract

We report a reversible biofunctionalization strategy for assembling a catalytically-active enzyme in a reusable bioMEMS that supports programmable bio-component assembly at selected sites. A control system supervises the sequential assembly of various bio-components onto specific electrodes in microfluidic channels. We demonstrate (a) the assembly of a Pfs enzyme at a specific electrode address and (b) that the enzyme is catalytically active in the bioMEMS. Enzymatic activity is robust, remaining over days. In addition, the chitosan-mediated biofunctionalization can be reversed, making a new type of biopolymer-based bioMEMS reusable for repeated assembly and catalytic activity.

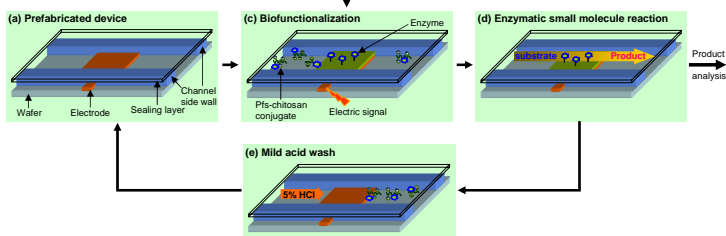
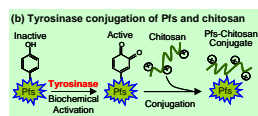
Method

Chitosan

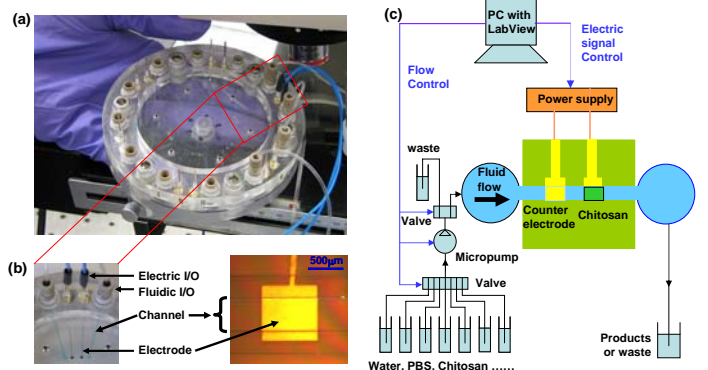


Programmable enzyme assembly and reusable bioMEMS

- Biochemical activation to prepare enzyme-chitosan conjugate
- Electrical signal-guided enzyme assembly (spatial and temporal control)
- Prefabricated device for biofunctionalization when needed
- Reusable bioMEMS device and low average usage-cost



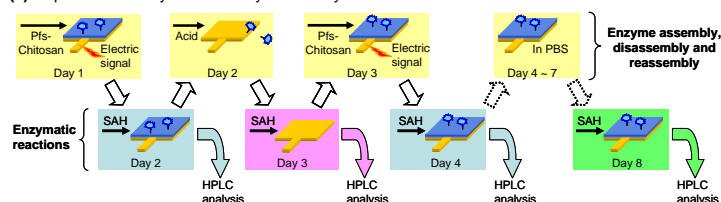
BioMEMS device and bioMEMS control system



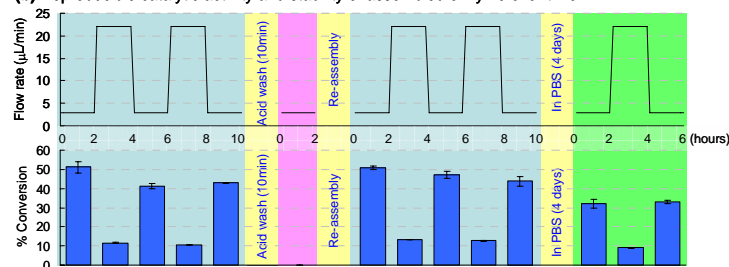
Results

Reversible enzyme assembly and catalytic activity

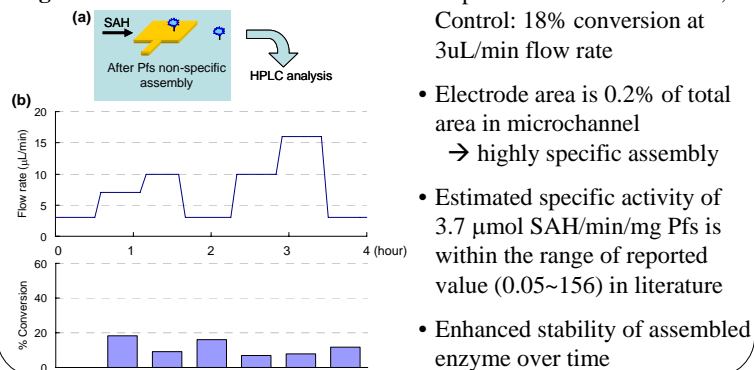
(a) Reproducible enzyme assembly and catalytic reactions



(b) Reproducible catalytic activity and stability of assembled enzyme over time



Negative control



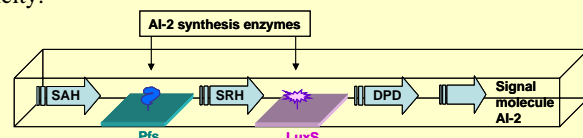
Conclusion and Future Work

This work demonstrates:

- Programmable enzyme assembly in bioMEMS (spatial and temporal)
- Reversibility of biofunctionalization ➔ Reusable bioMEMS
- Retained catalytic activity and enhanced stability of assembled enzyme

Metabolic engineering in bioMEMS

- ➔ Multi-step cell-signaling process (autoinducer-2 production)
- ➔ BioMEMS platform for quorum sensing (QS) to study bacterial pathogenicity.



Acknowledgements

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