



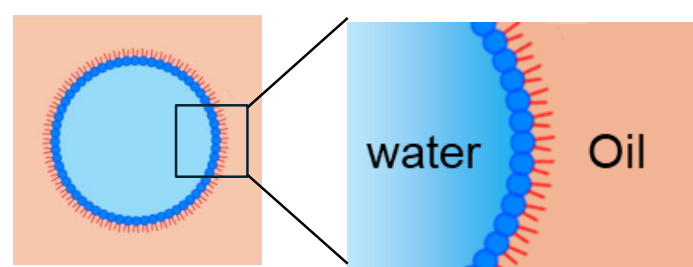
Preparation of Monodisperse Polymer Vesicles Using a Microfluidic Channel

Taiki Miyashita,¹ Satoshi Nanjo,² Yuki Gondo,¹ and Hiroaki Suzuki^{1, 2}

Background

Microdroplets

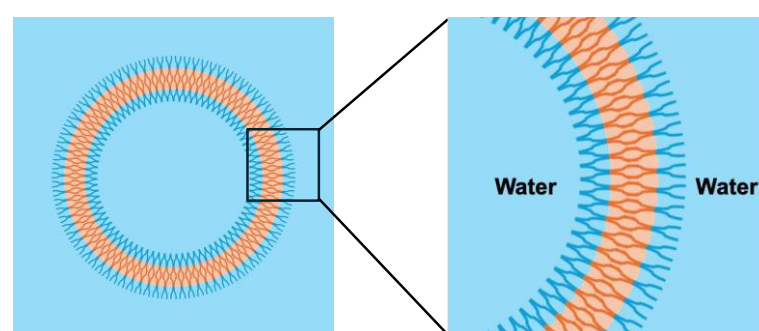
Microscopic reaction vessels where biochemical reactions take place, enabling rapid and efficient processes.



✓ Commonly used W/O droplets are not easy to handle due to the oil-based outer phase.

Polymer vesicles

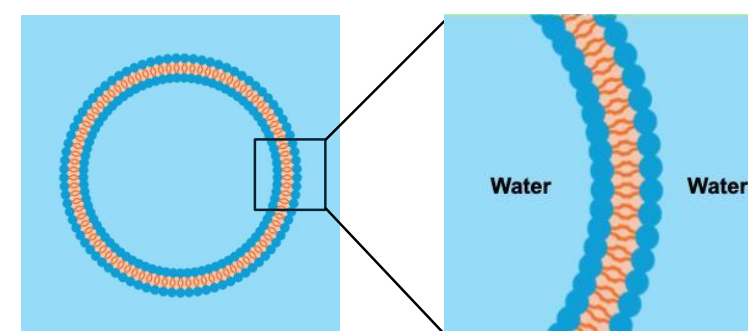
Microscale vesicles in which amphiphilic polymers form a bilayer membrane.



◎ High thermal and physical stability.

Liposomes

Microscale vesicles in which phospholipids form a bilayer membrane.

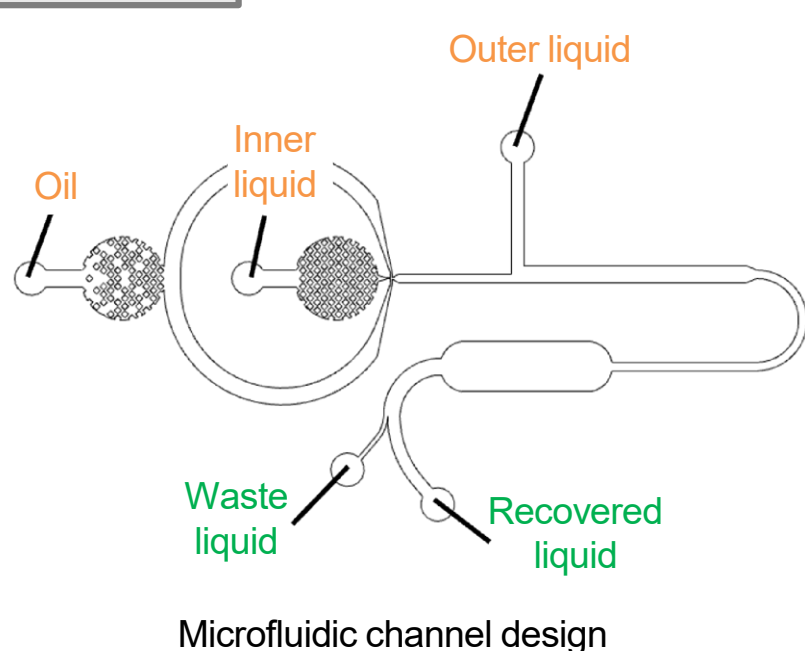


△ Low thermal and physical stability.

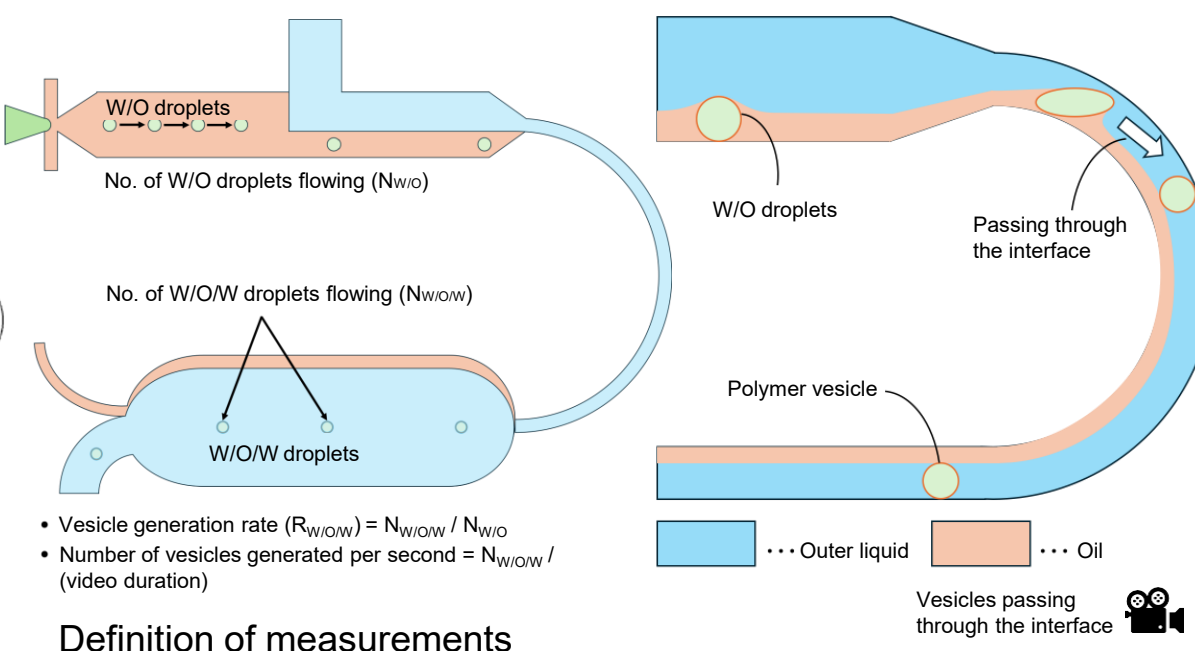
Research objective Preparation of polymer vesicles and their application as microreactors

Experimental Procedures

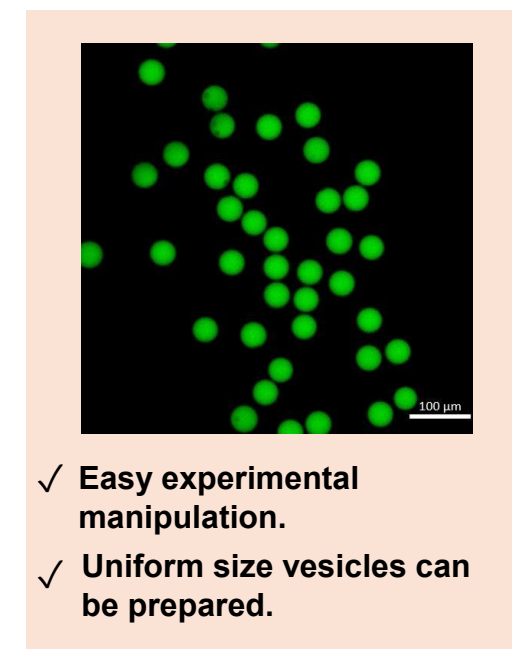
Preparation of monodisperse polymer vesicles using a microfluidic channel



Microfluidic channel design



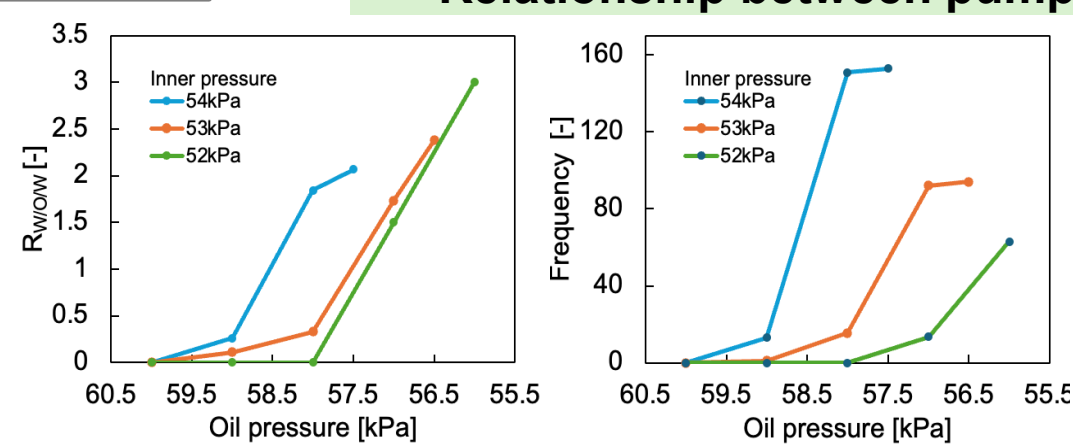
Definition of measurements



✓ Easy experimental manipulation.
✓ Uniform size vesicles can be prepared.

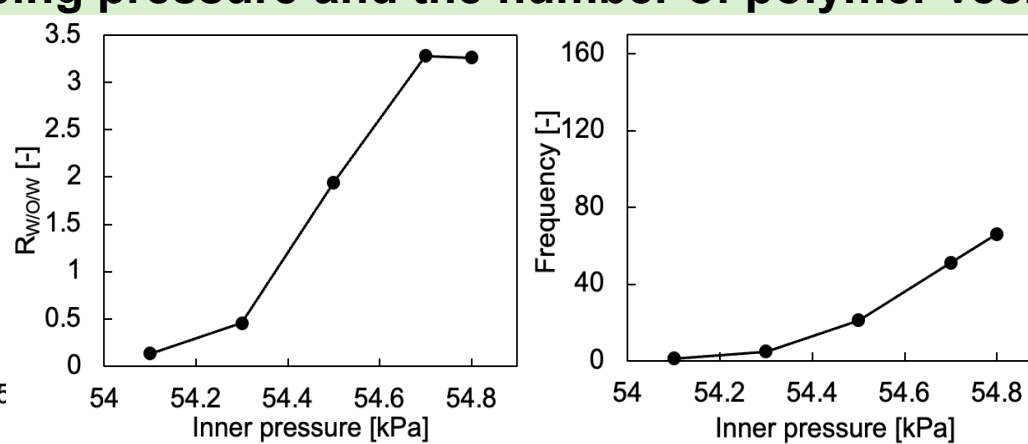
Results

Relationship between pumping pressure and the number of polymer vesicles generated



Pressure applied to the oil

(Left: vesicle generation rate, right: number of vesicles generated per second)

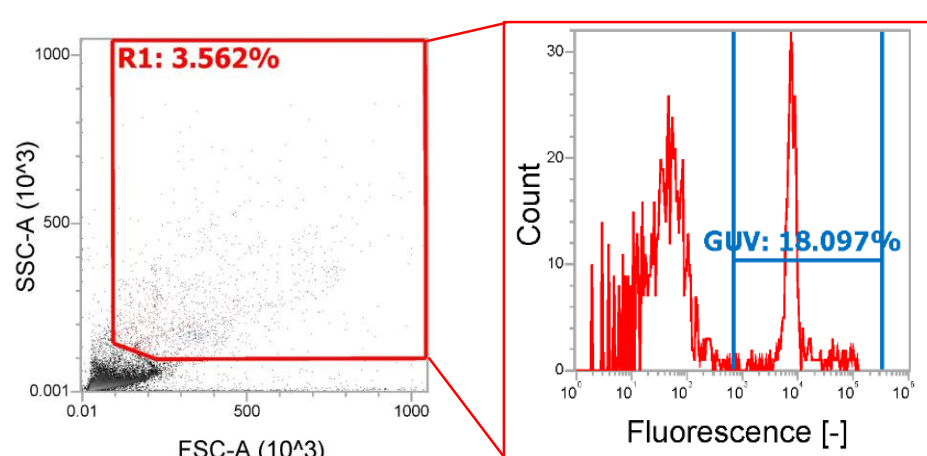


Pressure applied to the inner liquid

(Left: vesicle generation rate, right: number of vesicles generated per second)

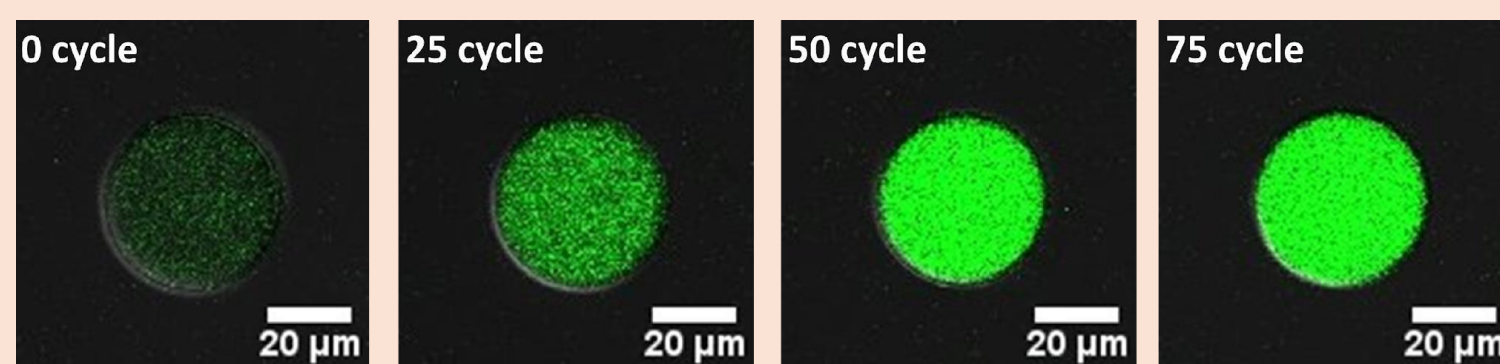
✓ Adjusting the pumping pressure enhanced the vesicle generation rate.
✓ Approx. 100 vesicles can be prepared per second.

Evaluation of polymer vesicles by FCM



✓ Polymer vesicles encapsulating fluorescent samples were confirmed by FCM.

Quantitative PCR inside vesicles



Reaction solution was sealed inside the vesicles with controlled temperature conditions.
✓ Quantitative PCR was successfully performed inside polymer vesicles.

Conclusions

- ✓ A method for the large-scale generation of polymer vesicles has been established.
- ✓ It has the potential to be used as a water-dispersible microreactor.

Future Prospects

We will investigate whether other reactions such as ddPCR and cell culture are possible inside the vesicles, with the aim of creating a versatile microreactor.