

## Abstract

Microfluidics is a field of study and technology that uses tiny channels to manipulate small amounts of fluids and control the particle size. This research focused on the design of microfluidic channels and the investigation of the obtained particles. The microfluidic was designed using Autodesk Fusion and made from polydimethylsiloxane. The particles were obtained from the reaction between sodium alginate and calcium chloride. Morphologies and sizes of particles were measured by optical microscopy (OM) and scanning electron microscopy (SEM). Fourier transform infrared spectroscopy (FT-IR) was used to analyze the chemical structure of particles. The results showed that the particle size was affected by the flow rate of fluids in each channel, which will be useful for controlling particle production to be suitable for future applications in biomedicine.

## Introduction

Drug delivery, tissue culture, and disease diagnosis are important for research. Therefore, there has been the development of devices at the particle level. The particles will be used as the basis for use in biomedical research. However, creating particles with traditional methods such as extrusion dripping or gas chromatography, the particle size cannot be controlled. Therefore, the development of microfluidic devices has been developed to control the synthesis of particle. Microfluidic has channels at the micrometer or nanometer level. It relies on controlling the flow rate of the solution inside the channel, forming droplets and should be cross-linked with a solution containing charged ions such as calcium chloride. Microfluidic devices offer the potential to automate a wide variety of chemical and biological operations, which is higher repeatability, rapid production and more precise particle size control for various applications in biomedical.

## Objective

- To design microfluidics in various patterns to generate particles.
- To synthesis core/shell particle.

## Methodologies

### 1 Designing and printing microfluidic channels.



### 2 PDMS molding

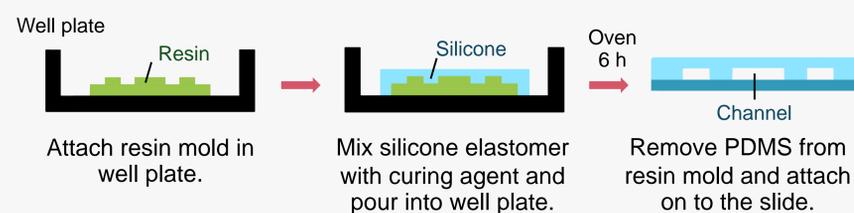


Fig. 1 Fabrication a device by reverse molding

### 3 Preparation of solution alginate solution

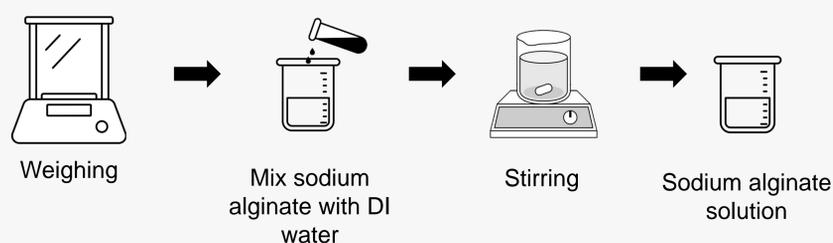


Fig. 2 Schematic diagram preparation the solution of Na Alginate.

### 4 Fabrication of alginate droplets

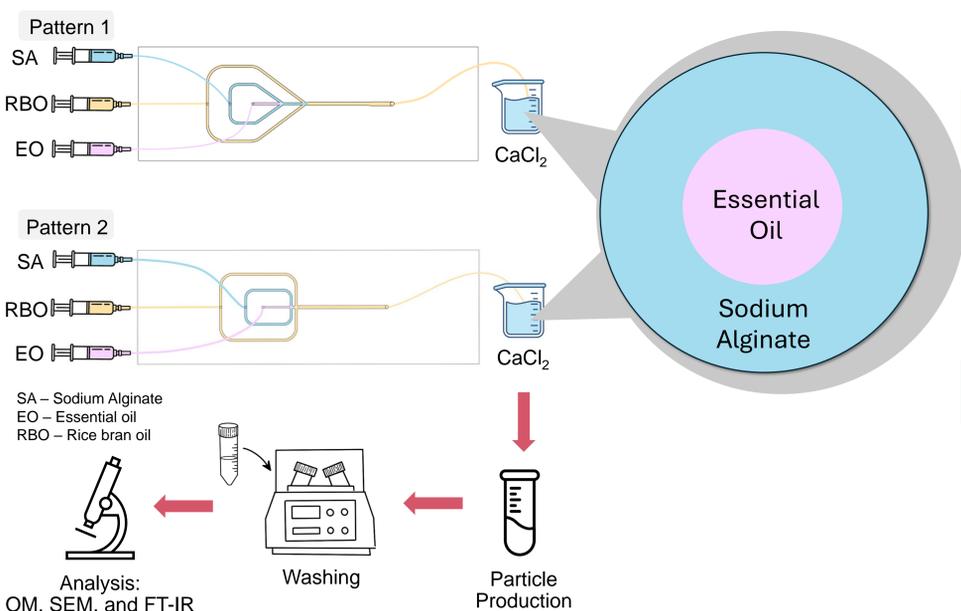


Fig. 3 Schematic diagram production of alginate particles.

## Results & Discussion

### Effect of the designing of microfluidic pattern on particle production

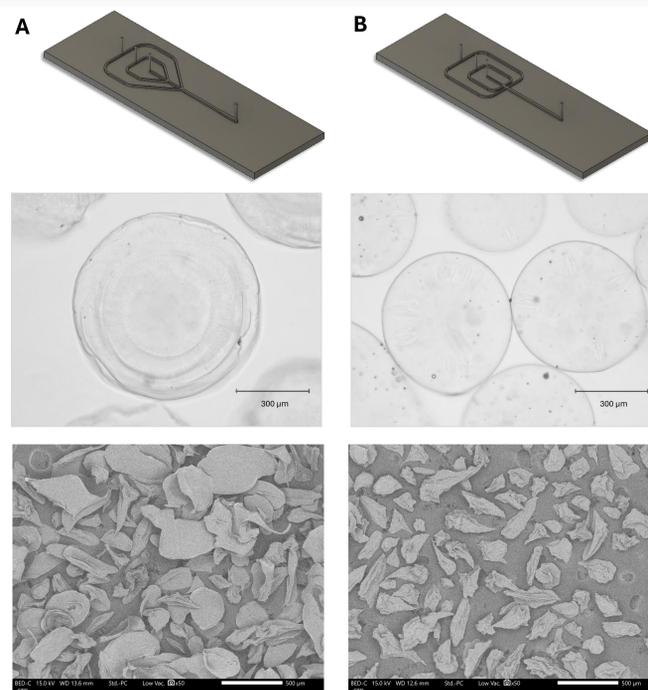


Fig. 4 The different designing of microfluidic pattern (A) and (B), OM, and SEM images of particles.

- Different designing of microfluidic can effected to generate the structure of particle.
- Pattern A produced the core/shell structure of particles.
- Pattern B produced the spherical particles of alginate.
- The structure of particles was confirmed by OM images.
- SEM images showed the morphology of particles in dry state.

### Chemical structure of particle production

- Wavenumber in the range of 1587-1417  $\text{cm}^{-1}$  indicated the carboxyl group ( $\text{COO}^-$ ) of alginate.
- Wavenumber in the range of 2927  $\text{cm}^{-1}$  and 2856  $\text{cm}^{-1}$  indicated the  $\text{CH}_3$  Stretching (methyl group) and  $\text{CH}_2$  stretching (methylene group) of essential oil.
- Wavenumber in the range of 1739  $\text{cm}^{-1}$  indicated the carbonyl group ( $\text{C=O}$ ) of essential oil.

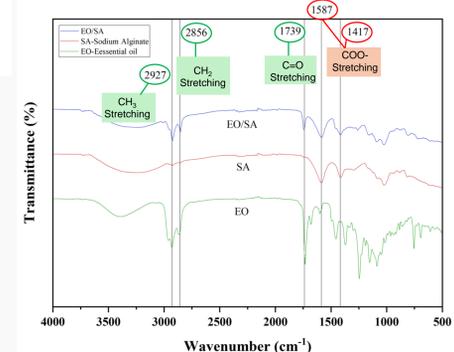


Fig. 5 The FT-IR spectra of EO, SA, and core/shell structure of EO/SA.

## Conclusions

- The different design of microfluidic pattern can be produced difference size and structure of particle.
- Microfluidic pattern A was suitable to produce the encapsulation of EO into alginate particle.

## References

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- Husnain Ahmed and Bjørn Torger Stokke. DOI: 10.1039/d1lc00111f

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