Control of Crystallization Processes for Oleogel under Application of an External Electric Field

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1. Introduction

Background

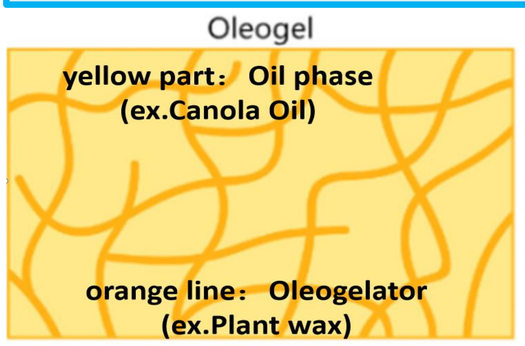
- Excessive intake of **saturated fat** has a significant impact on human health.
- **Oleogel** is the **best alternative** because it has a low calorie content. Therefore, oleogel has been widely studied by the food research.
- However, **It is difficult to manufacture the oleogel with high stability.**
- **So we want to get more stable oleogels in our production.**

What is more stable oleogels

1.The crystals are **denser**. This means the crystals' distance becomes closer, and the formation network of the sample is stronger.
2.**Higher melting point.** Since crystals are solids, when there are more crystals, it means a higher melting point.

Oleogel

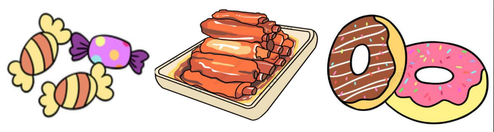
Purpose：To design healthier foods and replace saturated fats to get more unsaturated fatty acids.
Composition:
solid component (oleogelator) + liquid component (oil) = semi-solid state



Application

In cosmetics

In food fields



Previous Studies

- **Pressure: High pressure** technology in the food industry (*D_Farr -Trends in Food Science & Technology-Volume 1, July 1990, Pages 14-16*)
- **High-intensity ultrasound:** Effect of **high intensity ultrasound** on soybean and avocado oleogels (*A Rumayo-Escobar, M Morales-de la Peña, J de la Rosa-Millán, T Arredondo-Ochoa, E Dibildox-Alvarado- Food Structure volume 10 April 2023, 100315*)
- **Shear**: The Effect of **Shear** on the Microstructure and Oil Binding Capacity of Wax Crystal Networks(*Alaxie B.I & Alejandro G. M - Food Biophysics volume 10, pages403–415 (2015)*)

In recent years, it has been reported that the crystallization behavior of protein crystals can be controlled under the application of an external electric field.

Crystallization of high-quality protein crystals using an external electric field *H Koizumi- J.Appl. Cryst. 48, 1507-1513 (2015).*

Aim

We focus on the effect of the applied electric field on the crystallization behavior of oleogels.

2. Experimental

Materials

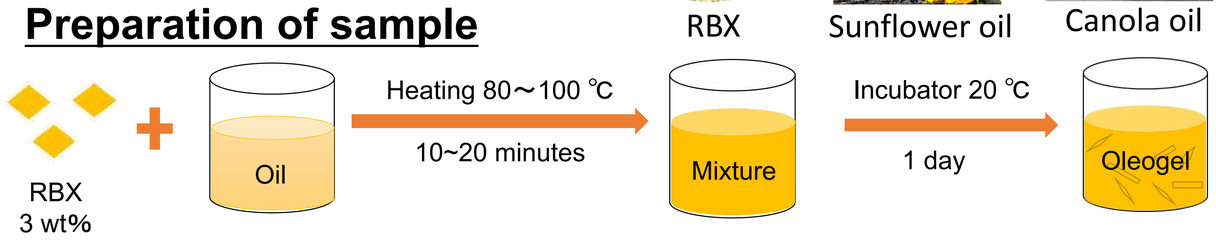
- **Oleogelator: Rice bran wax (RBX)**
- **Oil phase :Sunflower oil, Canola oil**


RBX

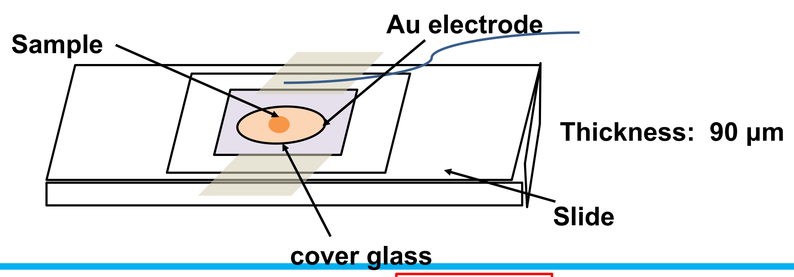

Sunflower oil

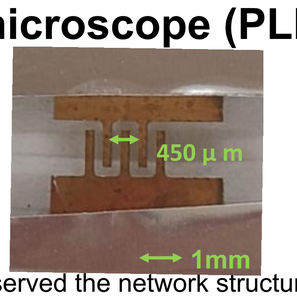

Canola oil

Preparation of sample

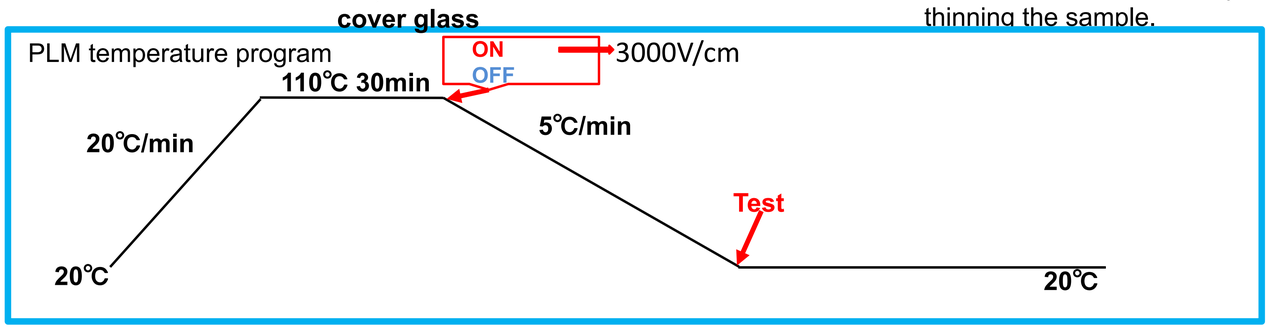


Microscope observation <Polarized light microscope (PLM)>



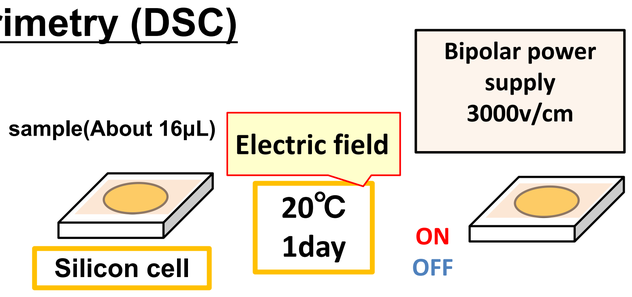


Observed the network structure by thinning the sample.

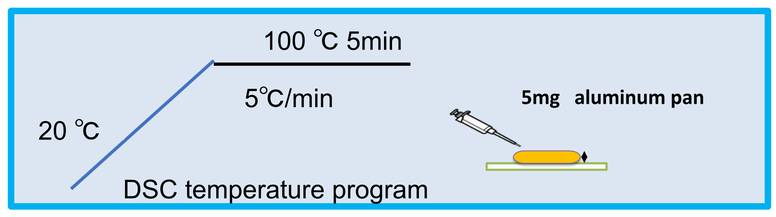


Differential Scanning Calorimetry (DSC)

Heating again

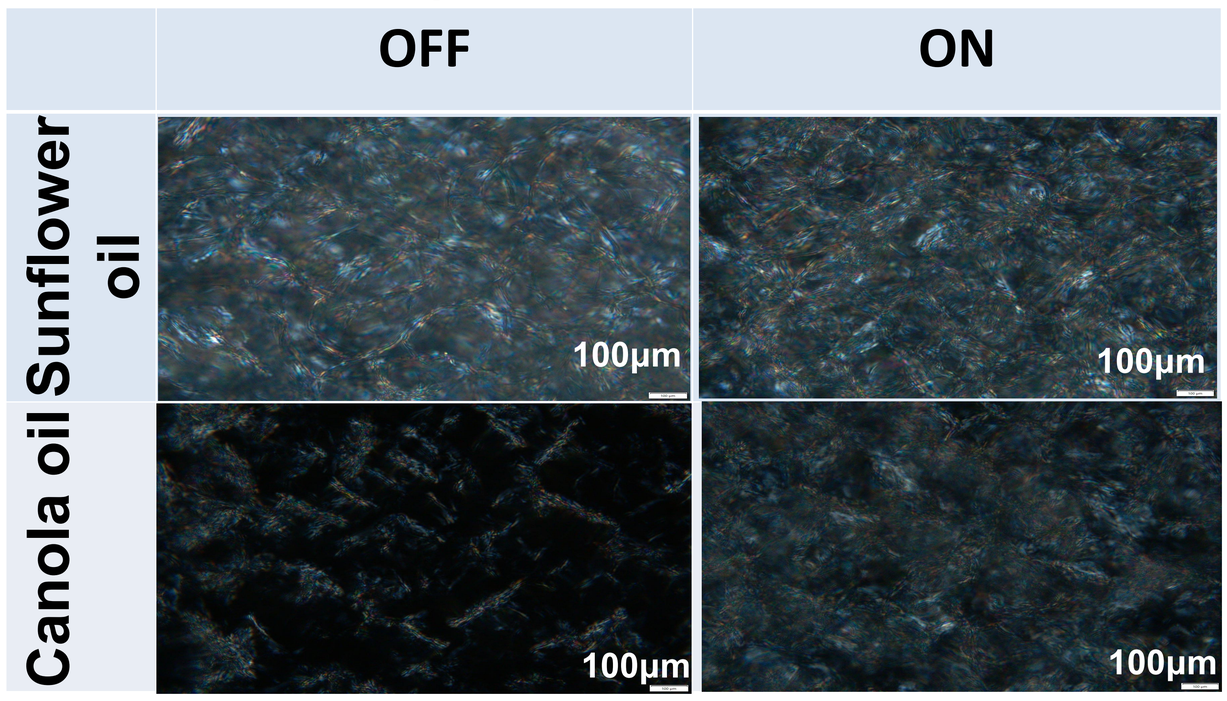


- A sample of 5mg was packed in an aluminum pan and tested the melting point of sample.



3. Results and Discussion

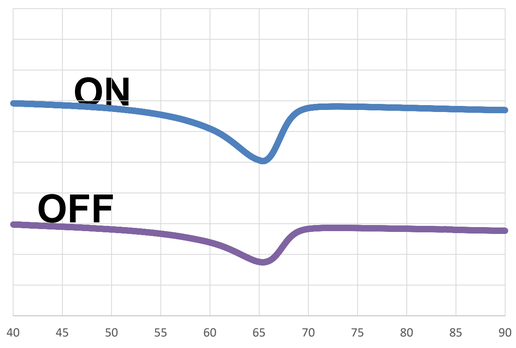
PLM 3wt% RBX oleogel



When [ON] :The crystals are denser and the formation network of the sample is stronger

DSC 3wt% RBX oleogel

3% RBX + sunflower oil

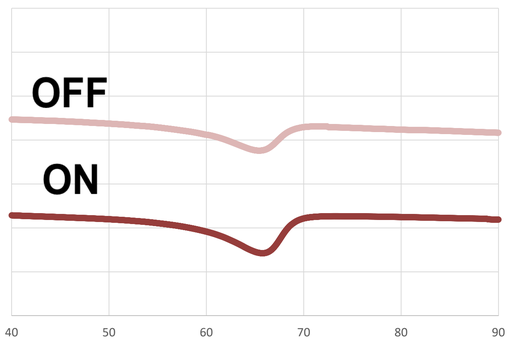


*: Melting point - **peak top temperature**

sample	Peak top (℃)	enthalpy （mJ/mg）
ON	65.53± 0.18	7.11± 0.71
OFF	65.11±0.16	6.16± 0.64

Compared with **[ON]** and**[OFF]:**When **[ON]**, the melting point and enthalpy were **higher.But look similar**

3% RBX +canola oil



*: Melting point - **peak top temperature**

sample	Peak top (℃)	Enthalpy （mJ/mg）
ON	65.92± 0.36	7.77± 0.47
OFF	65.59±0.43	6.27± 0.88

Compared with **[ON]** and**[OFF]:** When **[ON]**, the melting point and enthalpy were **higher. Specially,the enthalpy data**

Discussion

Oleogel has a stronger three-dimensional network and a higher melting point when an electric field is applied. Therefore, Applied electric field promotes crystal growth. We can get more stable samples for better production applications

4. Conclusion

Applied electric field promotes crystallization of samples

The crystals are denser when an electric field is applied.

Make the network stronger and the sample more stable