



RGJ Ph.D.

โครงการปริญญาเอกกาญจนาภิเษก

# Preparation of rewritable superhydrophobic based biopolymer composite for smart coating integrated with self-healing and anti-fouling

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## Abstract

This research aimed to develop a smart coating based on biopolymer composite. A copolymer carboxymethyl cellulose/polyvinyl alcohol crosslinked with glutaraldehyde (CMC/PVA) was reinforced with flower-liked zinc oxide (F-ZnO) at 0.1-0.7 wt%. The CMC/PVA/F-ZnO was coated on a glass substrate by spray and then treated with trichloro octadecylsilane (OTS). The coated glass with CMC/PVA/ 0.5 wt% F-ZnO showed a superhydrophobic surface with water contact angle of 153°. The obtained superhydrophobic surface also had an excellent antiadhesive bacteria performance up to 99.9% and self-healing performance in humid environments about 72.5%. Interestingly, the superhydrophobic coating can be removed from the substrate by immersing the coating in water for 1 h. Consequently, the substrate can be reused when it is no longer required for coating.

## Introduction



### Coating Agent

#### Advantages

- Low cost
- Antiadhesive bacteria
- Super hydrophobicity
- Rewritable properties

Biopolymer materials (Carboxy methyl cellulose, PVA), Nanoparticles (ZnO)



### Applications of superhydrophobic coating

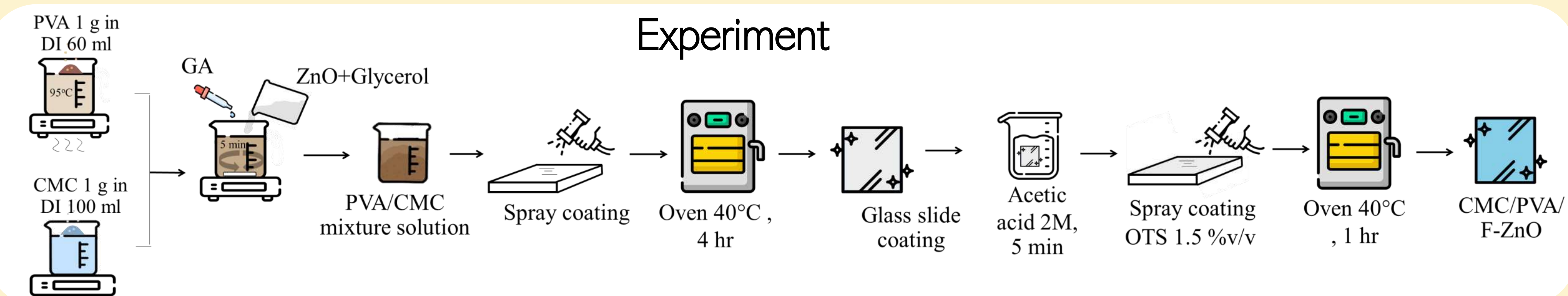
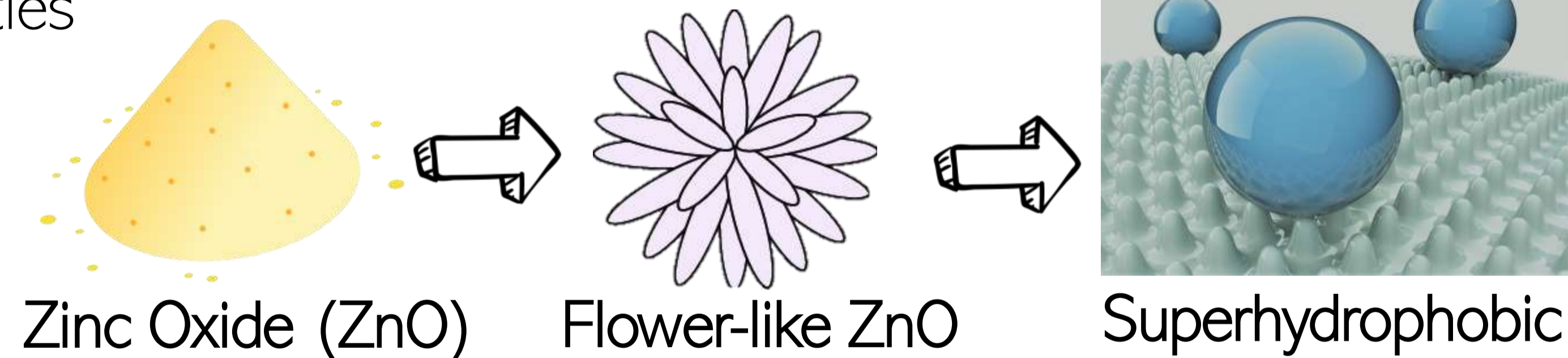
- Anti-fouling
- Self-cleaning
- Hydrophobicity
- Self-healing
- Rewritability

#### Disadvantage

- Poor water resistance.



### Surface modification

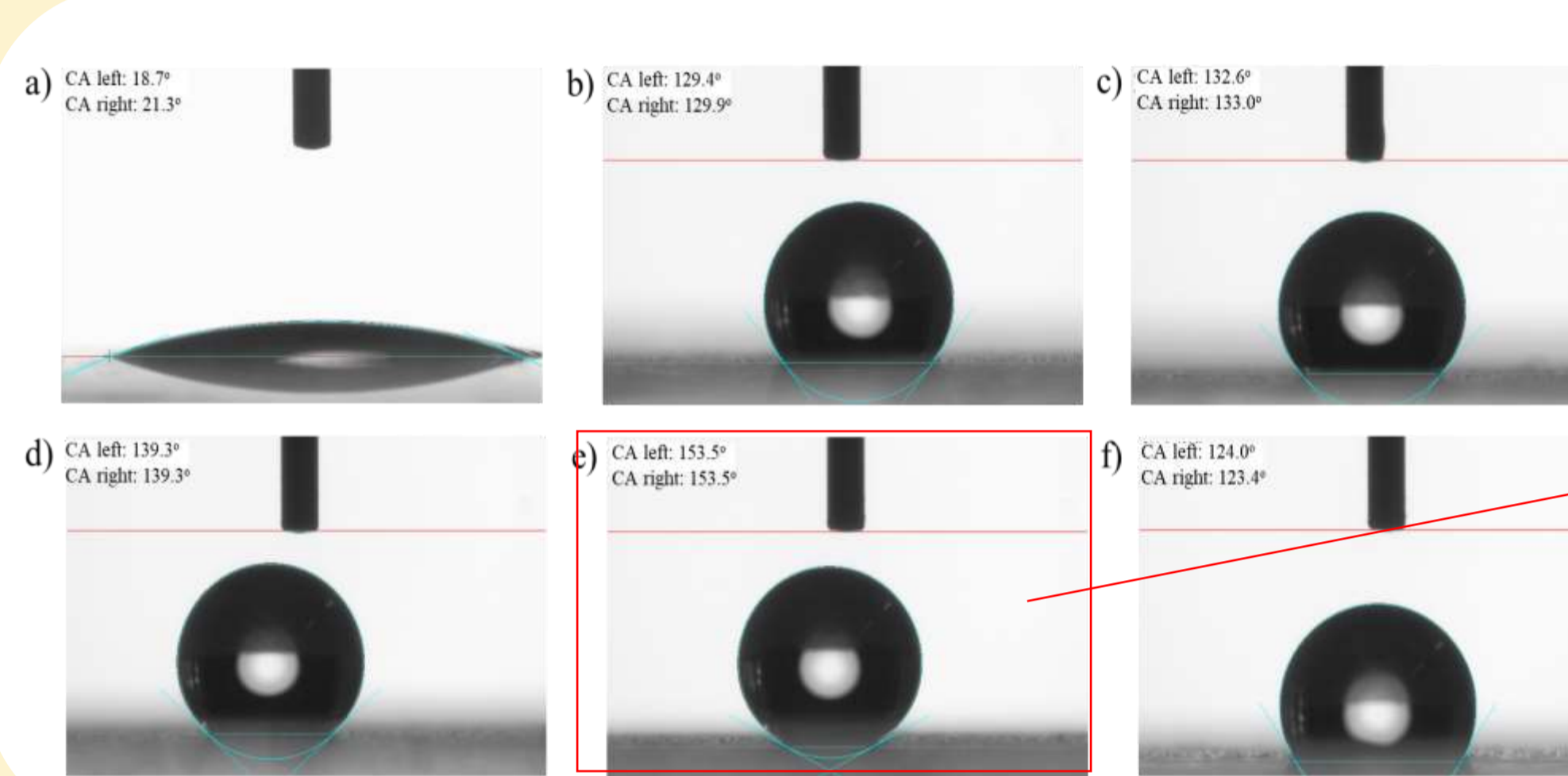


## Characterization

Properties	Methods
Superhydrophobic	Water contact angle (WCA)
Fourier-transform infrared (FTIR) spectroscopy	The spectrum was analyzed at 4000–500 cm <sup>-1</sup>

Properties	Methods
Self-Healing Behaviors	The width and length of scratch was measured using Olympus DP73 microscope digital camera
Bacteria Adhesion Assay	The bacterial colonies

## Result and discussion



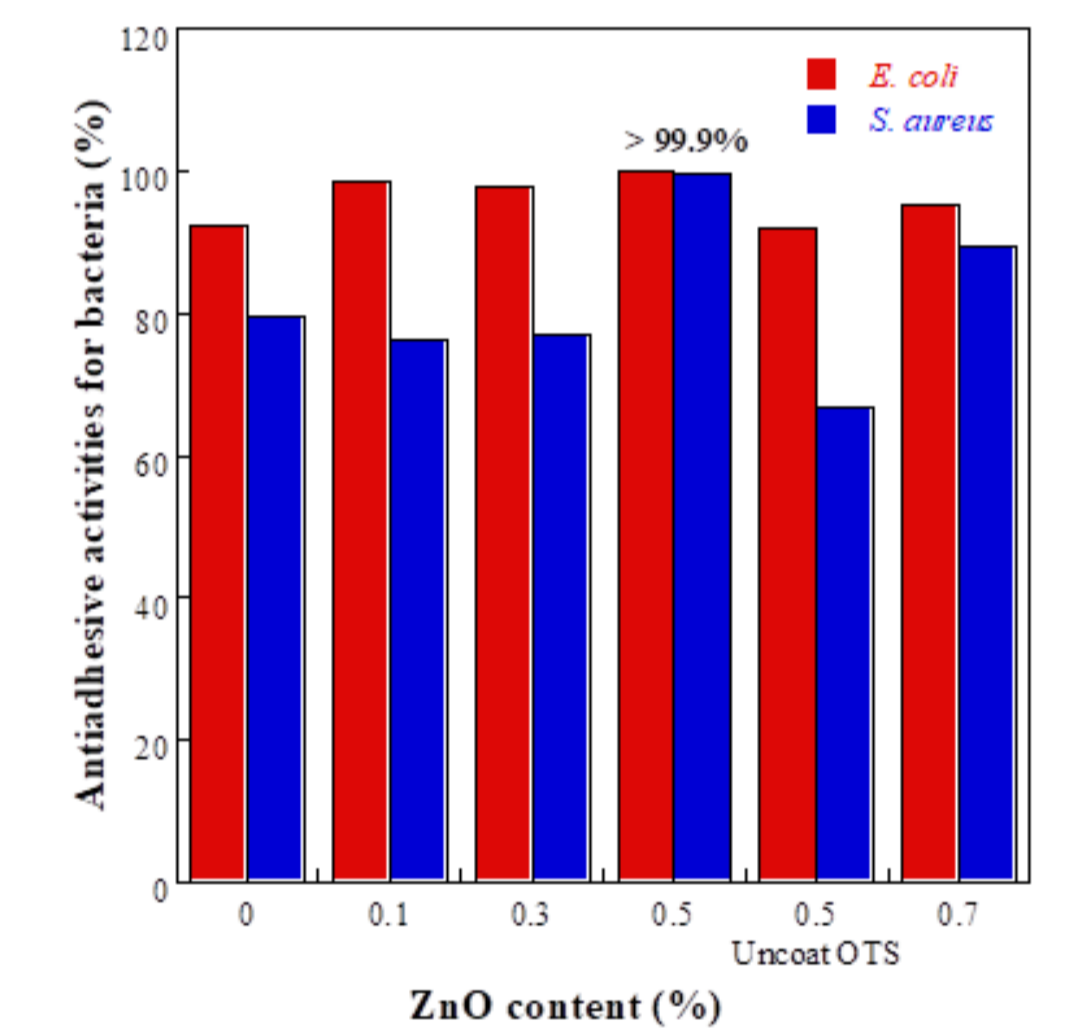
### Water contact angle

A surface with 90–150° WCA is called hydrophobic, whereas a > 150° WCA implies a superhydrophobic surface.

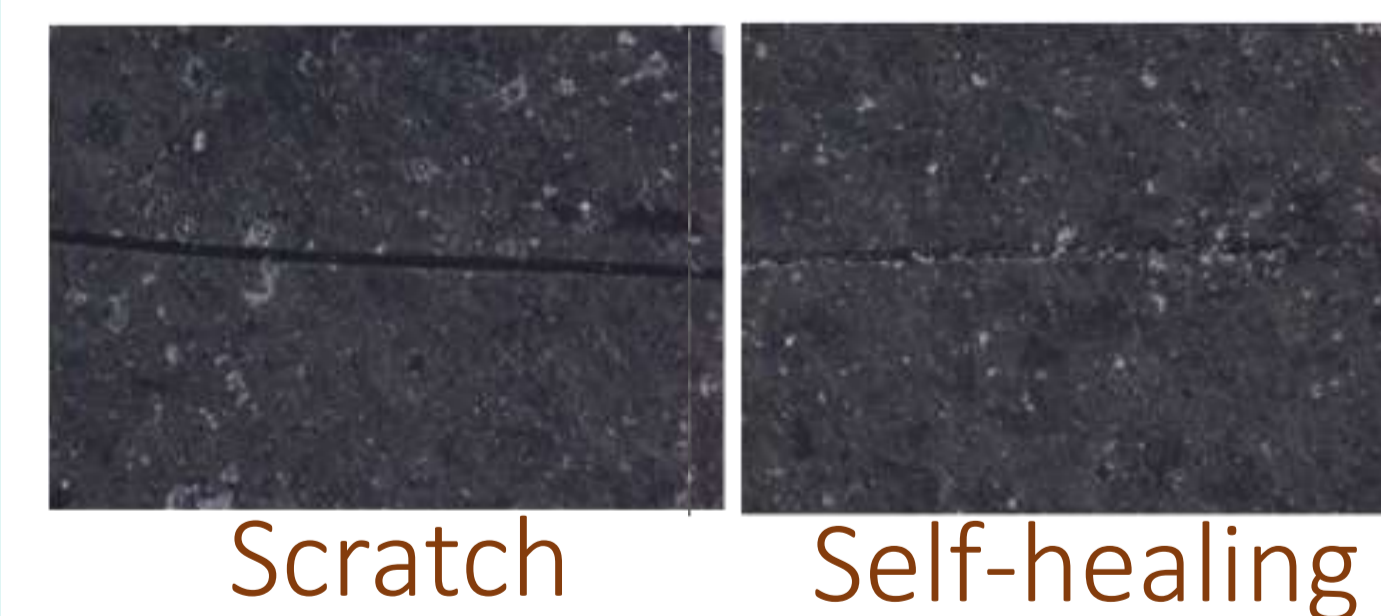
The coated glass containing 0–0.7 wt% ZnO ranged from 129.4 to 123.4°

### Antiadhesive activity of superhydrophobic bio composite

The antiadhesive efficiency after the bacterial incubation 24 hr on the sample surface. The CMC/PVA/F-ZnO-0.5 showed the highest antiadhesive efficiency is 99.9% which is consistent with the surface hydrophobicity.



### Self-healing ability of superhydrophobic



The CMC/PVA without ZnO and incorporated 0.1-0.7% ZnO showed self-healing ability in range of 47.07-72.47%

### Rewritable properties of superhydrophobic

The coated glass with 0-0.7 %wt of ZnO showed rewritability superhydrophobic coating that allows the substrate to be reused.

## Conclusion

In summary, we prepared a rewritable and eco-friendly superhydrophobic coating by a simple spray-coating method. A suitable 0.5% ZnO content in CMC/PVA polymer matrix was showed the superhydrophobic surface up to 153.5°, excellent antibacterial adhesion resulting in efficiently impede the adhesion of *E. coli* and *S. aureus* by over 99.9%, and self-healing ability up to 72.47% under humidity environment were successfully. As a result, rewritable and environmentally friendly superhydrophobic coatings should have a lot of applications in many fields

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