Evaluation of Air Retention of 3D printed Biomimetic Super-Hydrophobic Structures

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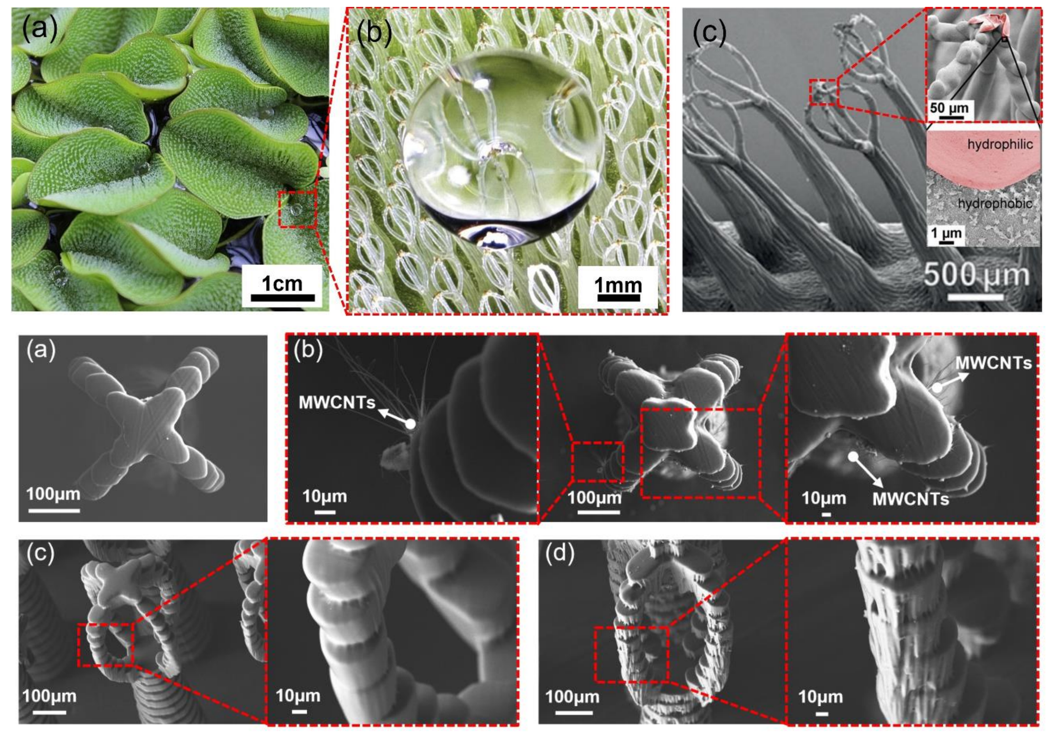
1. INTRODUCTION



Nature, with its complex hierarchical designs, has been a source of inspiration for technological advancements. *Salvinia Molesta*, a floating fern, exhibits remarkable superhydrophobic properties because of its unique eggbeater structures characterized by dual-scale roughness featuring microscale trichomes and nanoscale wax crystals, facilitating stable air retention underwater.

2. OBJECTIVE

The objective is to replicate Salvinia-inspired superhydrophobic structures using electrically assisted vat photopolymerization to study their air retention properties under varying parameters. The materials used for fabrication will be resin mixed with multi-walled carbon nanotubes (MWCNTs) in different concentrations.

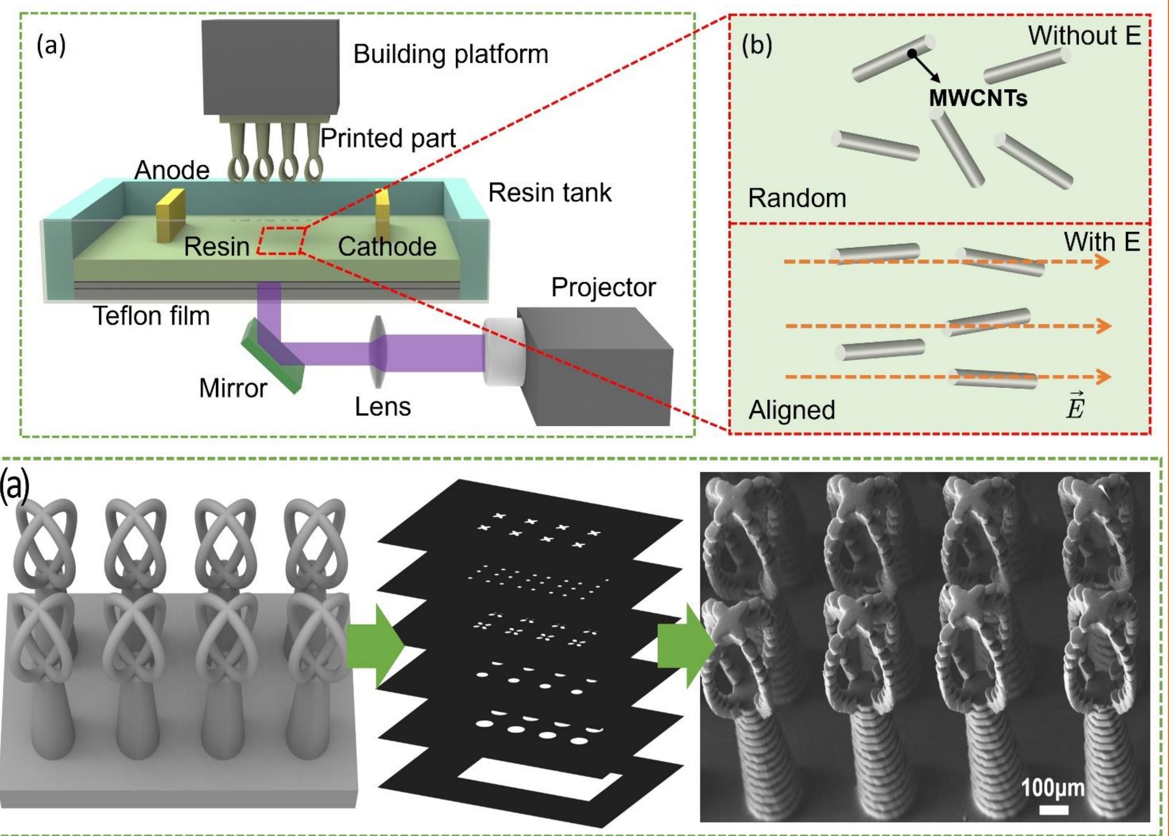
3. METHODOLOGY

Material Preparation
- 1. Preparing mixtures of varying MWCNT Concentrations
- 2. Curing property study

Modeling
- 1. Designing CAD models using SolidWorks.
- 2. Slicing the 3D model into continuous 2D layers

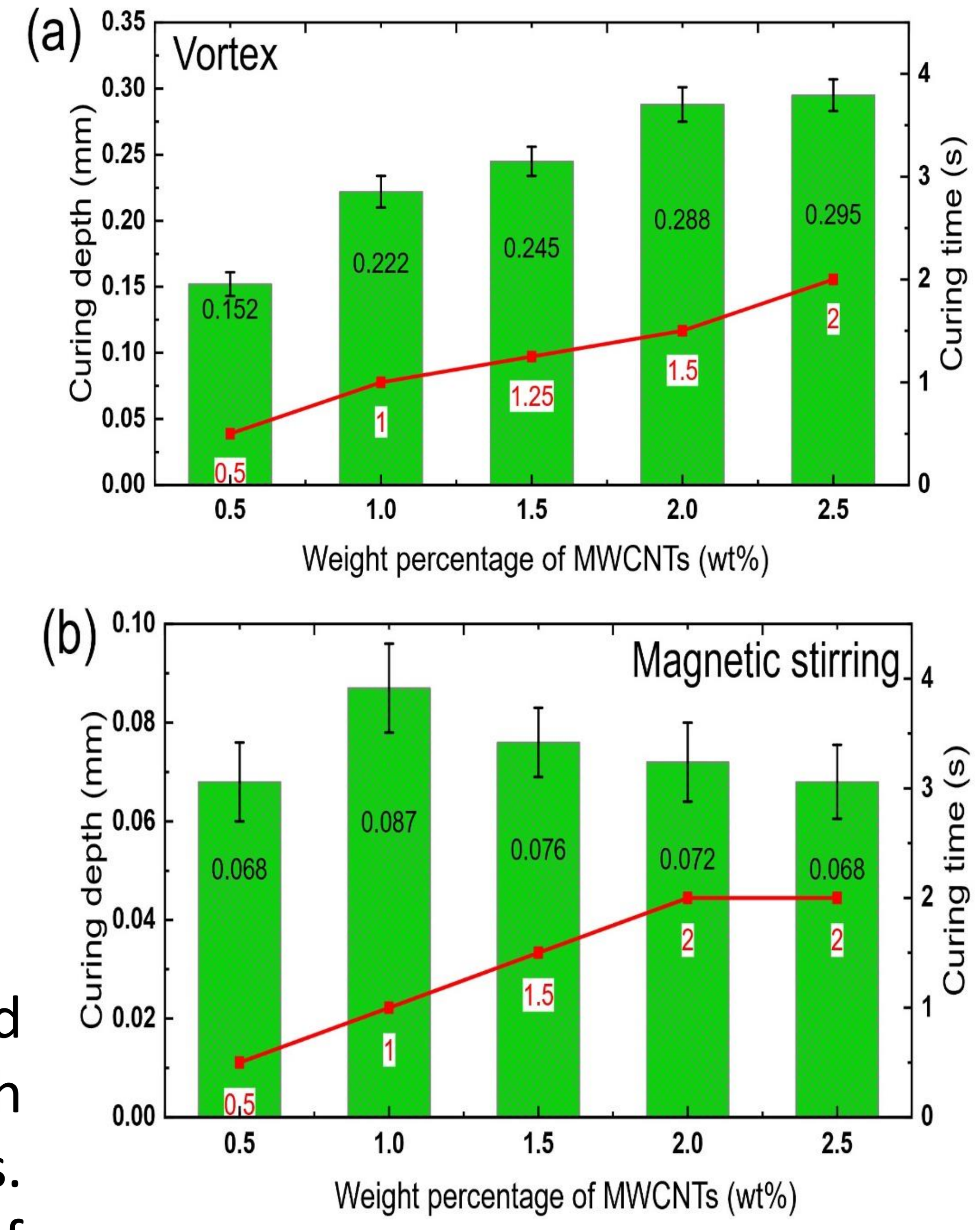
E-VPP
- Printing Samples of varying concentrations and parameters

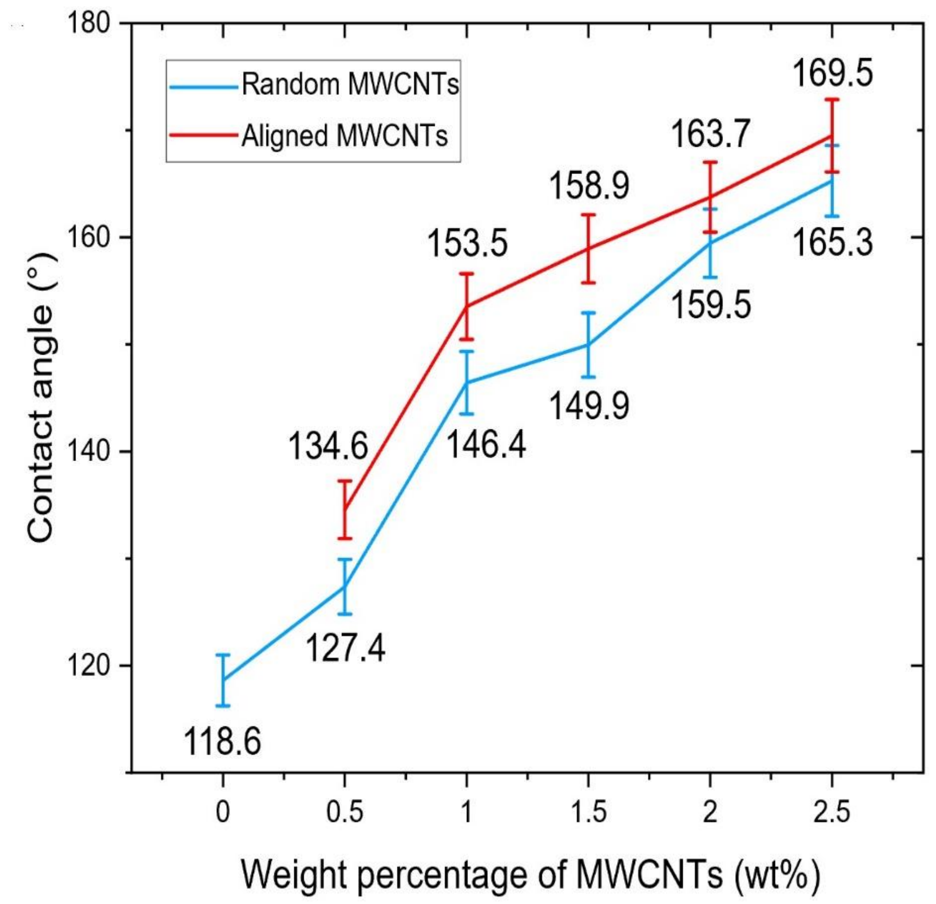
Air retention study
- Measuring Contact angles and adhesive forces.

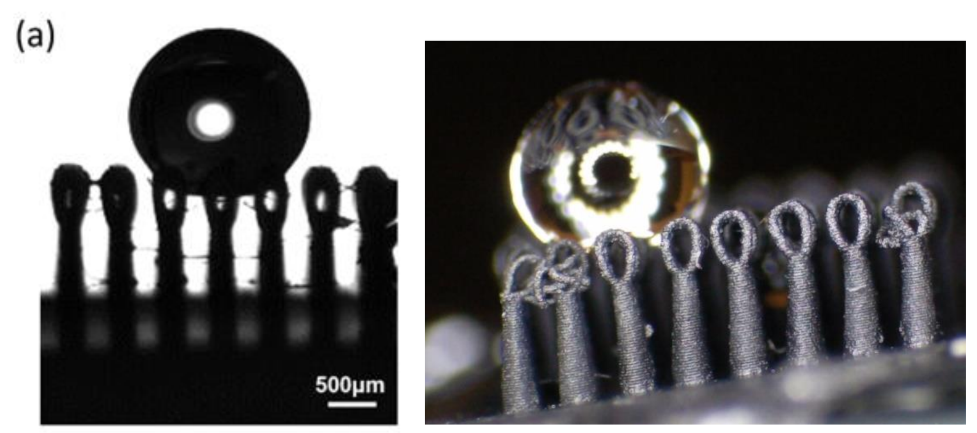


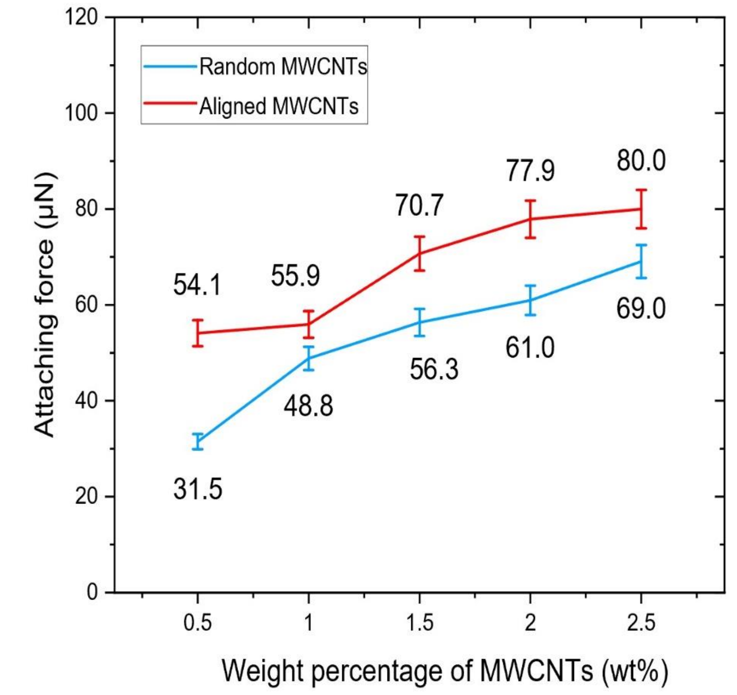
4. RESULTS

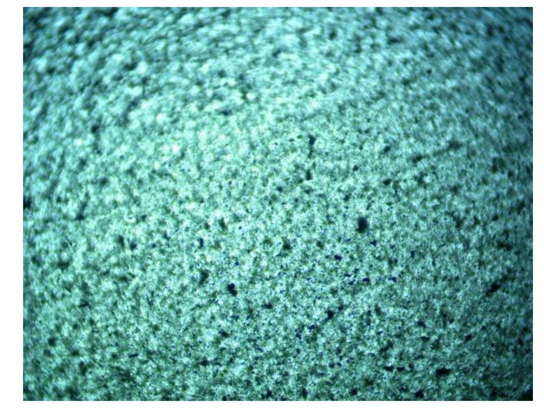
1. Vortex mixing leads to a gradual curing depth increase with MWCNT concentration. In contrast, magnetic stirring, with superior dispersion, yields shorter curing times and shallower depths
2. Magnetic stirred mixtures exhibit lower curing depth, while vortex mixtures tend to overcure quickly.
3. Contact angles were examined for MWCNT mixtures in both random and aligned structures. The highest contact angle (CA) of 169.492° was observed in the 2.5% mixture.
4. Maximum attaching forces were observed in the 2.5wt% MWCNTs mixture with aligned structures. Adhesive force increased from 31.5μN to 69μN with higher MWCNT percentages.



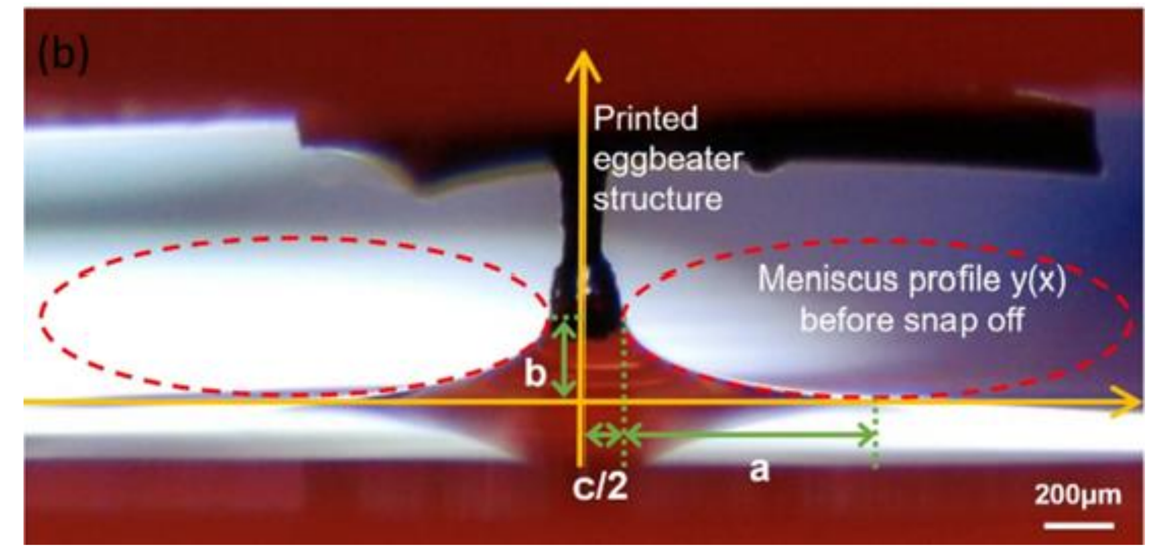








Dispersion of MWCNT in resin



5. CONCLUSION

1. MWCNT concentration affects curing, as higher concentrations cause slower curing due to light scattering and hindered photopolymerization.
2. Adding and aligning MWCNTs enhances superhydrophobicity and thus air retention. The nano- and micro-scale surface hierarchy enhances air retention properties by reducing solid-liquid interaction which minimizes contact area, enabling water droplets to remain spherical and slide off while retaining air.