Jun Soo Kim

· Ph.D course
· Department of Mechanical Engineering
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· Research interest: Phase change, Surface engineering, Heat transfer

Academic Experiences

Korea Advanced Institute of Science and Technology (KAIST) Feb. 2024 - Present
Ph.D Mechanical Engineering

Korea Advanced Institute of Science and Technology (KAIST) Mar. 2022 – Feb. 2024
M.S. Mechanical Engineering | GPA: 4.26 / 4.3

- Thesis: Enhancing Condensation Heat Transfer and Anti-frosting Performance through Robust Surface Engineering (Advisor: Prof. Youngsuk Nam)

Chung-Ang University Mar. 2016 – Feb. 2022
B.S. Mechanical Engineering | GPA: 4.45 / 4.5

- Thesis: Computational Validation of Single Bubble Evaporation Heat Transfer Models in Microchannel Heat Sink (Advisor: Prof. Hyoungsoon Lee)

Journal Publications

1) Sehyeon Cho, Daeyoung Kong, Gyohoon Geum, Sukkyung Kang, Jin Hyeuk Seo, **Jun Soo Kim**, Seong Hyuk Lee, Jungho Lee, and Hyoungsoon Lee, "Experimental and computational investigation of heat transfer performance of two-phase closed thermosyphon", **Applied Thermal Engineering**, Vol. 235, pp. 121327 (2023)

2) **Jun Soo Kim**, Kyounghwan Song, Jung-Yeul Jung, Choongyeop Lee, Youngsuk Nam, "Improving the anti-fouling performance of superhydrophobic surfaces via cyclic restoration of a gas layer on the surface", **Surfaces and Interfaces**, (2025)

Conference:

1) Jaehwan Shim, **Jun Soo Kim**, Seungtae Oh, Jungho Lee, Jungchul Lee, and Youngsuk

Nam, "Ceria/Polymer Hybrid Coatings for Long-Lasting Superhydrophobic Condensers", *KSFM Summer Conference,* Korea, June 29 ~ July 1, 2022.

2) Sehyeon Cho, Daeyoung Kong, Gyohoon Geum, **Jun Soo Kim**, Seong Hyuk Lee, Jungho Lee, Hyoungsoon Lee, "Numerical Prediction of Visualization and Temperature Distribution of Two Phase Closed Thermosyphon with OpenFOAM", *ASME InterPACK,* USA, October 25 ~ 27, 2022.

3) **Jun Soo Kim**, Jaehwan Shim, and Youngsuk Nam, "The Effects of Heat Exchanger Edge Incorporated by Ceria/PVDF Hybrid Coating for Anti-frosting Performance", *KSME Fall Conference,* Korea, November 9 ~ 11, 2022.

4) **Jun Soo Kim**, Jaehwan Shim, Jungchul Lee, and Youngsuk Nam, "Ceria-based Superhydrophobic Heat Transfer Surfaces for Long-lasting Dropwise Condensation", *KSFM Winter Conference,* Korea, November 30 ~ December 2, 2022.

5) Jaehwan Shim, **Jun Soo Kim**, Jungchul Lee, and Youngsuk Nam, "Ceria-Based Robust Superhydrophobic Surfaces for Heat Pipe Applications", *International Heat Pipe Conference and International Heat Pipe Symposium,* Australia, February 5 ~ 9, 2023.

6) **Jun Soo Kim**, Jaehwan Shim, Jungchul Lee, and Youngsuk Nam, "Inducing sustainable dropwise condensation by scalable and durable superhydrophobic heat transfer surface", *KSME Spring Conference,* Korea, April 19 ~ 22, 2023.

7) Jaehwan Shim, Kihwoon Shim, **Jun Soo Kim**, Seokwan Rho, Soosik Bang, Yongwoo Kim, Bumjun Park, Rishi Raj, and Youngsuk Nam, "Strategies for Enhanced Dropwise Condensation by Incorporating Interfacial Adsorption of Amphiphilic Molecules", *KSME Spring Conference,* Korea, April 19 ~ 22, 2023.

8) **Jun Soo Kim**, Jaehwan Shim, and Youngsuk Nam, "Ceria-based Superhydrophobic Surfaces for Long-lasting Dropwise Condensation", *The 11th International Conference on Boiling & Condensation Heat Transfer (ICBCHT),* United Kingdom, May 15 ~ 17, 2023.

9) **Jun Soo Kim**, Changwan Ryu, and Youngsuk Nam, "Thermally conductive and robust dropwise condenser surface", *KSFM Winter Conference,* Korea, November 29 ~ December 1, 2023.

10) **Jun Soo Kim** and Youngsuk Nam, "Robust Dropwise Condenser Surface for Thermosyphon", *KSFM Summer Conference,* Korea, July 3 ~ 5, 2024.

11) **Jun Soo Kim**, Seokwan Roh, Minjeong Kang, Donghyeong Lee, Sung Gap Im, and Youngsuk Nam, "Tailoring nanoscale polymer film deposited via initiated chemical vapor

deposition (iCVD) for dropwise condensation", *2025 GRC for Micro and Nanoscale Phase Change Phenomena,* United States, January 12 ~ 17, 2025.

Award:

1) "Outstanding Research Presentation Award" from *KSFM Winter Conference,* Korea, November 29 ~ December 1, 2022.
2) "Best Poster Award" from *2025 GRC for Micro and Nanoscale Phase Change Phenomena, United States of America,* January 12 ~ 17, 2025.

Patent:

1) Jun Soo Kim, Youngsuk Nam, Rak Yeong Yang, Jungho Lee, "Apparatus for heat pipe inside coating", Korea patent 10-2024-0026191, 2024.

Project:

1) **Surface engineering for high heat transfer and Anti-frosting Performance**

   LG Electronics, 2022.03 ~ 2023.02

2) **Tailoring nanoscale condensation phenomena and enhancing heat/mass transfer utilizing surface charge control**

   National Research Foundation of Korea (NRF), 2022.03 ~ 2027.02

3) **Core Technology and Module Development in Boiling-type Heat Pipe Heat Exchanger**

   Korea Energy Technology Evaluation and Planning (KETEP), 2022.03 ~ 2025.12

4) **Permanent Dropwise Condensation via Amphiphilic Additives in Vapor Phase**

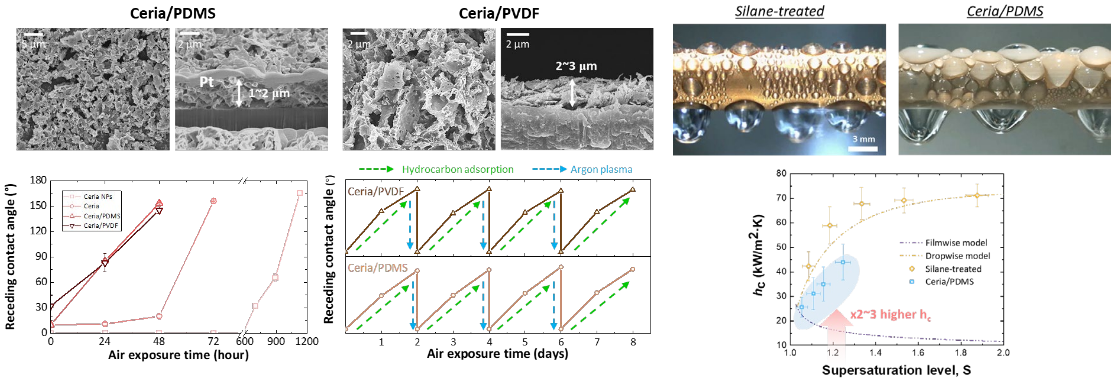
   National Research Foundation of Korea (NRF), 2022.03 ~ 2023.12

5) **Inducing Dropwise Condensation and Maximizing Heat Transfer Performance of Low-GWP Refrigerants via Homogeneous Polymer Deposited via initiated-Chemical Vapor Deposition (iCVD)**

   KAIST Venture Research Program for Graduate & Ph.D students, 2025.04~2025.12

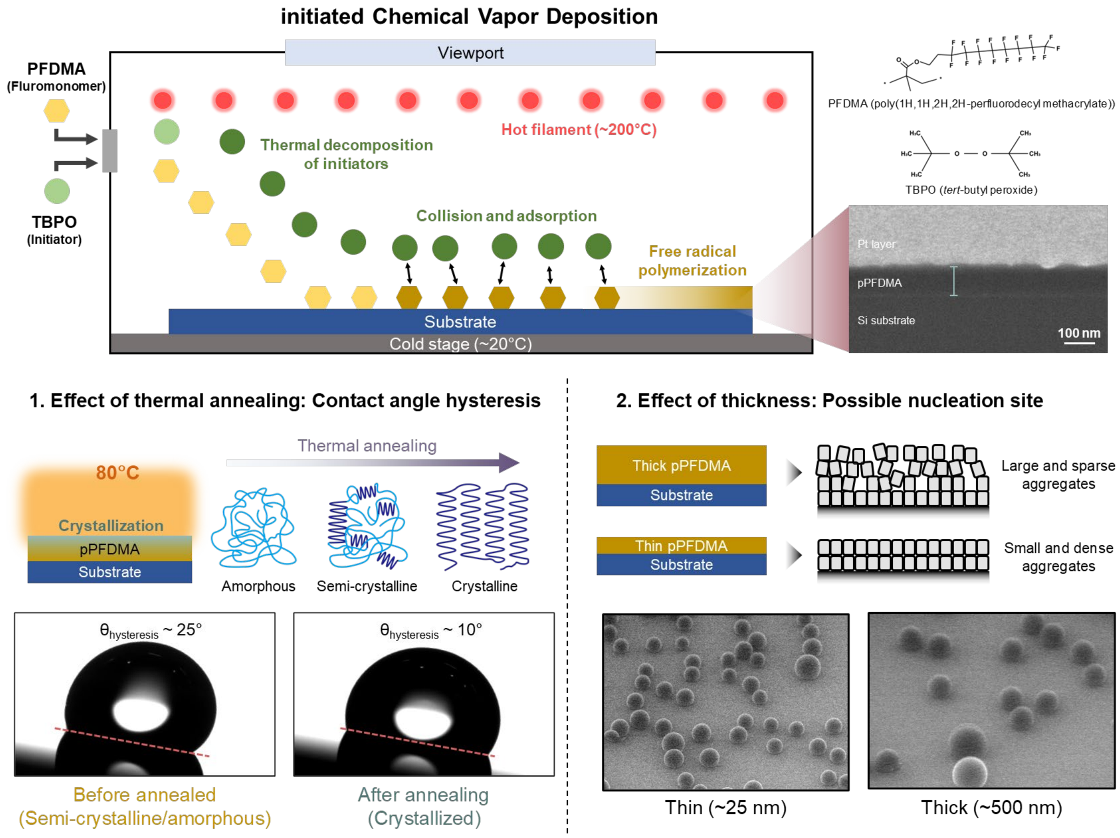
Research Topics:

1) Surface Treatment for Long-lasting Dropwise Condensation:



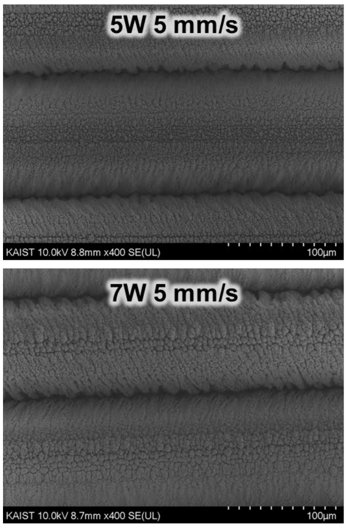
Here, we propose a robust ceria-based superhydrophobic surface for long-lasting dropwise condensation, where the superhydrophobicity is induced by hydrocarbon adsorption on the surface due to ceria, not by coating itself. The surface characterization results indicate that rapid self-recovery of superhydrophobicity (~48 hours) is possible by incorporating polymeric binder as a hydrocarbon source. The developed surface can provide enhanced durability even after various harsh environmental conditions, including mechanical, chemical, and frosting damages. The heat transfer performance was 2~3x higher than the filmwise mode, and the enhanced performance was maintained over a prolonged period due to the sustainable dropwise mode compared to conventional hydrophobic coating. Our results suggest that the ceria-based superhydrophobic surface can promote long-lasting dropwise condensation, facilitating effective heat transfer in practical applications where poor heat transfer performance is prevalent due to the filmwise mode.

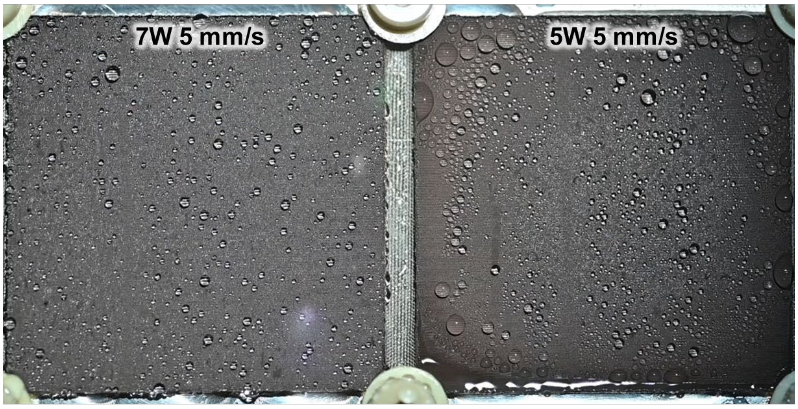
2) Tailoring nanoscale polymer film for enhanced dropwise condensation



In this study, we explore how poly(3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-heptadecafluorodecyl methacrylate) (pPFDMA) films, deposited using iCVD, affect dropwise condensation. We tested three coating thicknesses—25 nm, 100 nm, and 500 nm—examining their surface, mechanical, and chemical properties using contact angle measurements, X-ray diffraction (XRD), and atomic force microscopy (AFM). Additionally, we studied the effect of thermal annealing on droplet mobility. As coating thickness increased, surface roughness and contact angle hysteresis rose due to increase of semi-crystalline aggregates. However, thermal annealing caused the polymer structure to reorganize into crystalline structure, reducing surface roughness and hysteresis, resulting in a more uniform, low-hysteresis surface (<10°). This led to smaller droplet departure sizes and faster droplet removal rates. In contrast, the thickest coating (~500 nm) maintained higher hysteresis even after annealing, limiting performance. Overall, the 25 nm and 100 nm thermally annealed coatings exhibited stable, enhanced dropwise condensation under varying subcooling conditions. These results highlight the potential of iCVD-deposited fluoropolymer coatings for improving condensation efficiency, offering valuable insights for the design of advanced heat and mass transfer systems.

3) Effect of femtosecond laser-based surface structures on condensation





Jumping + Dropwise condensation

The femtosecond laser (FSL) is a laser processing technique that enables precise surface manipulation and even applications like graphene synthesis. Consequently, our research focuses on creating a robust and scalable heat transfer surface achievable exclusively through FSL. Our objective involves developing a hierarchical micro/nanostructure mimicking the lotus effect, aiming to achieve a surface capable of sustaining jumping/dropwise condensation even under high supersaturation levels. This endeavor seeks to explore novel possibilities in heat transfer enhancement and surface engineering.