# Jun Soo Kim

- Ph.D course
- Department of Mechanical Engineering
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- Email: john97kim@kaist.ac.kr
- Research interest: Phase-change heat transfer, Nano-engineered surface, Anti-frosting


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## Academic Experiences

Korea Advanced Institute of Science and Technology Ph.D (2024.03 – Present)

Korea Advanced Institute of Science and Technology M.S (2022.03 – 2024.02)

Chung-Ang University B.S. (2016.03 – 2022.02)

## 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) Jaehwan Shim, Tonmoy Sharma, Kihwoon Shim, **Jun Soo Kim**, Seokwan Rho, Soosik Bang, Yongwoo Kim, Bumjun Park, Rishi Raj, and Youngsuk Nam, "Cascading Condensation", *In preparation* (2023)

## Conference Presentations:

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 11$^{th}$ 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.

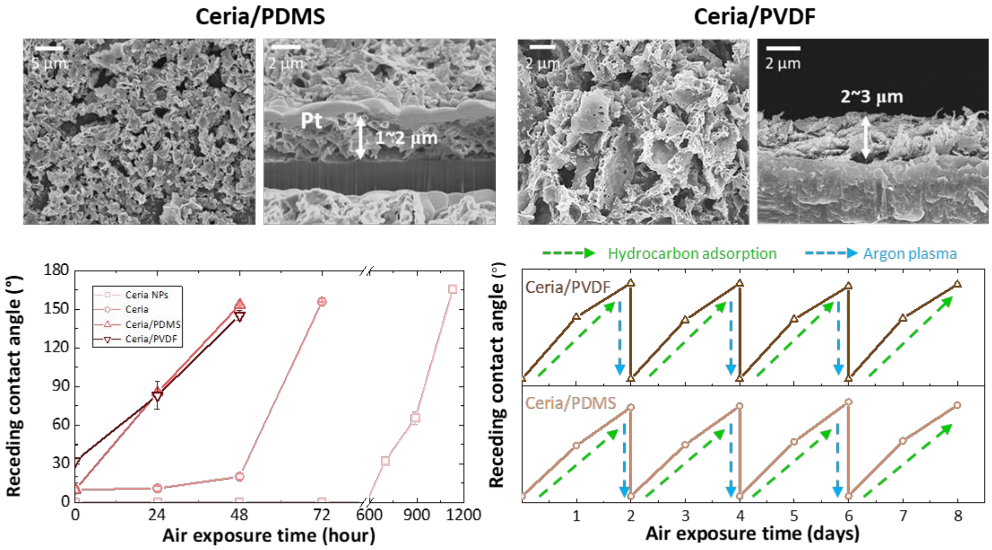
## Award:

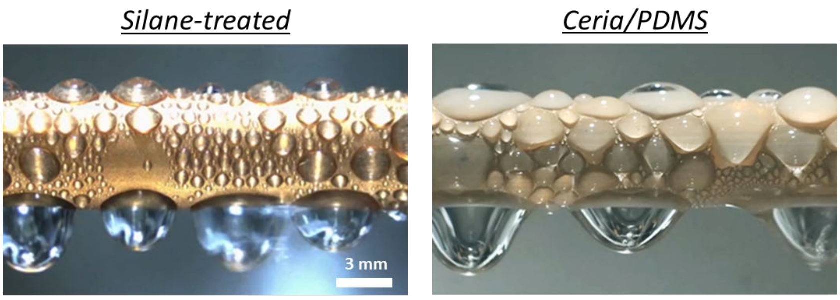
1) “Outstanding Research Presentation Award” from *KSFM Winter Conference,* Korea, November 29 ~ December 1, 2022.

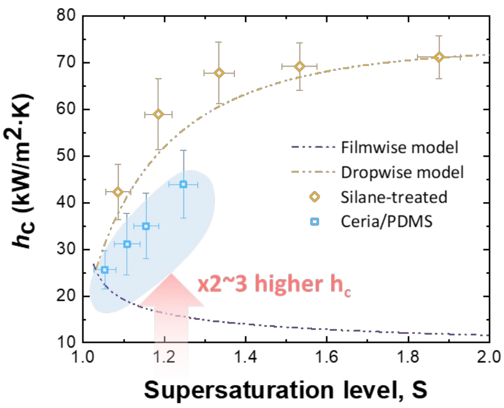
## Patent

## Research Topics:

### 1) Surface Treatment for Long-lasting Dropwise Condensation:

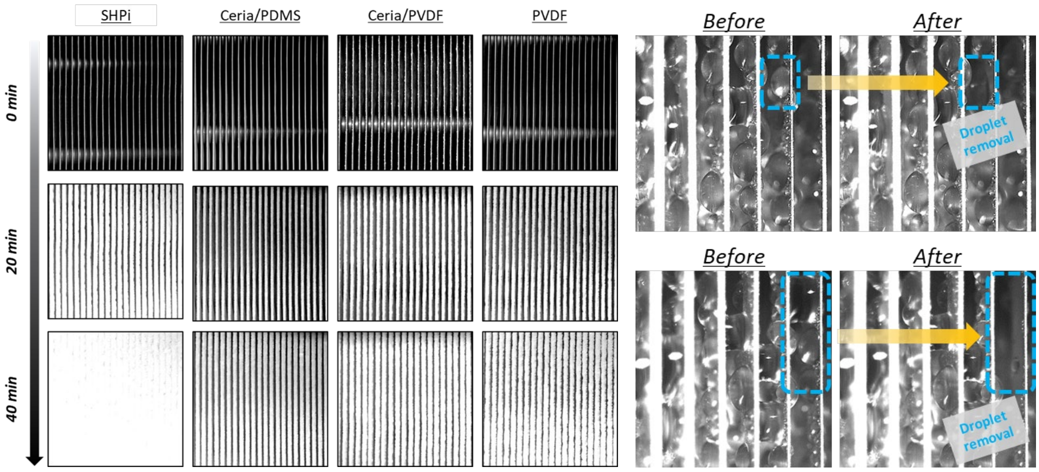



Water vapor condensation occurs frequently in diverse industrial fields; therefore, enhancing the condensation heat transfer performance can increase the overall system's efficiency. Dropwise condensation induced by a superhydrophobic surface generally leads to improved performance compared to filmwise condensation by the frequent shedding of condensed droplets. However, finding a superhydrophobic surface with appropriate durability remains challenging owing to the harsh environment encountered by many condensers. 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) Anti-frosting Performance for Commercial Heat-Exchanger**




We conducted the heat exchanger frosting experiment in a temperature/humidity-controlled room to investigate the applicability and the effect of edge-coating on the heat exchanger. A commercially used superhydrophilic fully coated sample, PVDF edge-coated sample, ceria/PVDF edge-coated sample, and ceria/PDMS edge-coated sample were tested to check its anti-frosting performance. In the case of the ceria/PDMS fully coated sample, we used the result from the previous study since the testing condition was identical. The visualization of each sample during the experiment is shown in the figure. The frosting rapidly accumulated on the commercially used superhydrophilic heat exchanger, which blocked the air passing through the heat exchanger. After 40 minutes of experiment, the front side was fully covered with frosting. On the other hand, ceria/polymer edge-coating delayed the frost propagation and accumulation at the edge, which resulted in a lower air side pressure drop compared to the superhydrophilic sample.Moreover, the frost suppression that occurred at the edge-coated heat exchangers led to an enhanced heat transfer rate. Concurrently, the heat transfer rate of all heat exchanger samples exhibited a consistent drop due to the surface temperature of the heat exchanger being consistently maintained at approximately -12 degrees, much below the freezing temperature. Furthermore, despite the fact that the edge-coating exhibits a greater pressure drop and lower heat transfer rate compared to the fully coated sample in the previous study, it can still be applied to an already installed heat exchanger using a simpler fabrication process than the full coating. Additionally, only approximately 5% of the surface area needs to be coated, making it a cost-effective option.