

**CUHK Convocation Outstanding Services
and Creativity Student Awards 2025/26**
香港中文大學校友評議會傑出服務及創意學生獎 2025/26

Name 姓名	Ho Cheuk Hei, Billy (何卓熙)
Major 主修	Energy and Environmental Engineering (Elite Stream)

I have developed an innovative passive personal cooling system that integrates advanced materials science with thermal engineering principles to solve the persistent challenges in personal thermal management. The system combines a eutectic sodium chloride brine phase change material, a hydrophobic silica aerogel insulation layer, and a radiatively selective polyethylene membrane in a synergistic four-layer architecture.

Scientific Innovation: The core creative breakthrough lies in the material integration strategy. Through independent literature review, I identified nanoporous polyethylene's potential as a radiative thermal gate, a concept originally demonstrated for textiles, and adapted it for static cooling applications. This enables asymmetric heat transfer: the membrane is transparent to mid-infrared radiation from the human body (8–14 μm) while blocking convective and conductive heat gain from the environment.

Material Science Contributions: I systematically evaluated multiple PCM candidates (pure water, NaCl brine, CaCl_2 brine) and membrane materials (Celgard® 2500, structural roofing membrane), establishing that NaCl brine at 23.3 % offers optimal performance with its -21°C melting point, $\sim 280 \text{ kJ/kg}$ latent heat, and minimal 2% volume expansion during freeze-thaw cycles. The aerogel layer exploits the Knudsen effect for superior insulation, maintaining user-side surface temperatures (5–7) $^\circ\text{C}$ above the dew point to eliminate condensation.

Experimental Validation: The prototype achieves over six hours of continuous cooling, a 7.7-fold improvement over commercial gel pads with zero condensation under simulated Hong Kong summer conditions (30 $^\circ\text{C}$, 70% RH). Systematic testing quantified cooling power at $6.5 \pm 0.3 \text{ W}$, efficiency at 28.5%, and confirmed the system's reusability and cost-effectiveness at HKD \$ 10.1 per unit.

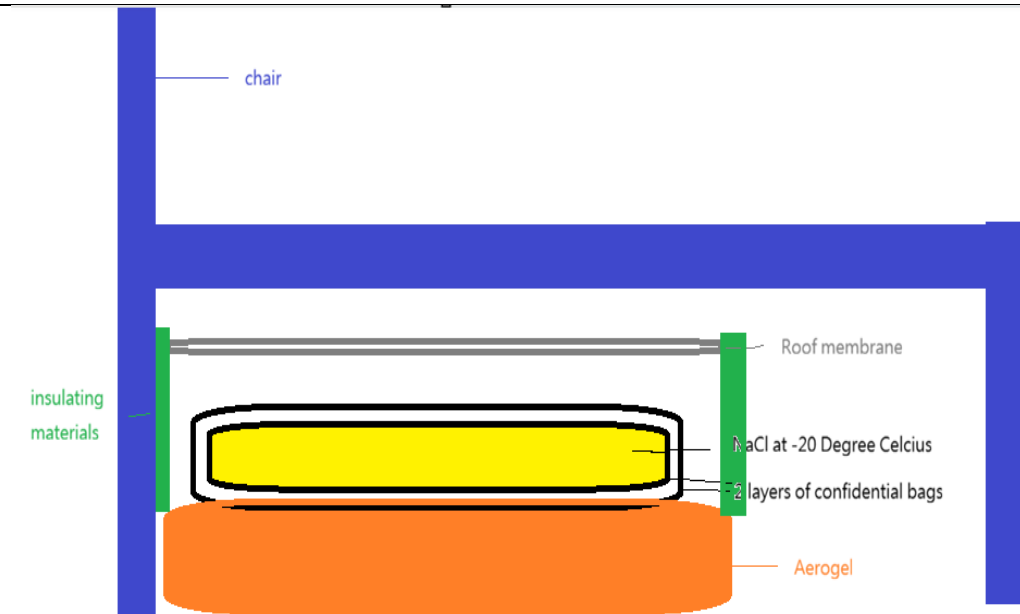
Broader Impact: This work contributes to sustainable thermal management by offering a passive, energy-free cooling solution that complements air conditioning systems. Potential applications include ergonomic seating for outdoor workers, medical therapeutic devices, and portable personal cooling, with projected energy savings of 30.7 kg CO_2 annually per user.

Gratitude to CUHK Convocation:

I am profoundly grateful to the CUHK Convocation for establishing this award that recognizes and encourages student creativity in the natural sciences. This recognition affirms the value of independent, interdisciplinary research and motivates me to continue pursuing innovative solutions to pressing global challenges.

I extend my deepest appreciation to my supervisor, Professor Chen Chun of the Department of Mechanical and Automation Engineering, whose transformative guidance and intellectual mentorship fundamentally shaped this project. His insightful suggestions, generous provision of laboratory resources, and unwavering encouragement turned conceptual barriers into creative breakthroughs.

I also thank all tutors in Professor Chen's research group for their technical guidance, and my family for their endless emotional support throughout this journey. The Convocation's commitment to fostering student innovation has been instrumental in my development as a researcher and reinforces my aspiration to contribute meaningfully to sustainable thermal management technologies for energy-poor communities and low-carbon urban environments.



The experimental prototype illustrates the integrated four-layer design: the radiatively selective membrane (top) suspended above the NaCl brine PCM core (centre), with hydrophobic silica aerogel insulation (bottom) providing thermal isolation and condensation prevention.