Environmental Research, Technology Demonstration and Conference Project

ECF Project:	ECF 2020-119
Project Title:	Solar-harvesting transparent smart window for building applications
Principal Investigator:	Dr Li Weihong, Department of Mechanical and Aerospace Engineering, The Hong Kong University of Science and Technology. With effect from 1 November 2021, the project was transferred to the Department of Mechanical Engineering, City University of Hong Kong
Total Approved Grant:	$482,592 (ECF & WWGF: 50/50)
Duration:	1/1/2022 to 31/03/2023
Project Status/Remarks:	Completed
Project Scope:	This project aims to develop a multifunctional transparent smart window to achieve high visibility, low radiant heat transmittance, and high thermal insulation. The window is composed of a transparent aerogel for high heat insulation and a transparent solar absorber for high visibility and lowradiation transmittance. The transparent solar absorber allows transmittance of visible light, absorbs ultraviolet (UV), near-infrared (NIR) radiation and converts it into heat for heating flowing air within the window gap as a solar-air heating system. A prototype smart window is built, followed by field test. Based on the preliminary study, the transparent solar absorber can transmit 72% of visible light and absorb 64% of solar energy. The team's goal is to promote the system to the construction industry in Hong Kong. The project team anticipates that the transparent smart window can decrease building energy consumption and contribute to a cleaner environment for Hong Kong.
Summary of the Findings/Outcomes:	In this project, we develop a dual-band selective solar harvesting (SSH) window to realize full-spectrum utilization. A transparent photovoltaic, converting ultraviolet into electricity, and a transparent solar absorber, converting near-infrared into thermal energy, are integrated and coupled with a ventilation system to extract heat for indoor usage. Compared to common transparent photovoltaics, the SSH window increases solar harvesting efficiency up to threefold while maintains a considerable visible transmittance. Simulations suggest that the SSH window, besides generating electricity, delivers energy savings by over 30% higher than common smart windows. This is the first integration of transparent photovoltaic and transparent solar absorber into a window, which may open up a new avenue for the development of energy-efficient buildings.