PROJECT TITLE: Composite Smart Window Technology for Advanced Building Fenestration

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Project keywords: smart window; nanocomposite; energy efficacy; smart glazing

Proposed start date: Monday 3 June 2024

Project description:

The energy consumption attributed to heating, cooling, and lighting in buildings constitutes over 40% of carbon emissions. Achieving the net zero target necessitates effective control of energy ingress and egress within buildings. To address this challenge, there has been a surge in demand for improved energy efficiency and visual comfort in building design, leading to the emergence of innovative high-performance smart glazing systems employing advanced composite materials.

This project envisions a pioneering research initiative aimed at developing new technologies to significantly reduce energy demand in the built environment at a reasonable cost. The primary objective is to mitigate heat loss, regulate incoming solar radiation to optimize solar gain, minimize heat loss during winter, and mitigate heat gain in summer by employing reversible window configurations, all while ensuring optimal natural lighting conditions with minimal glare (See Figure 1).

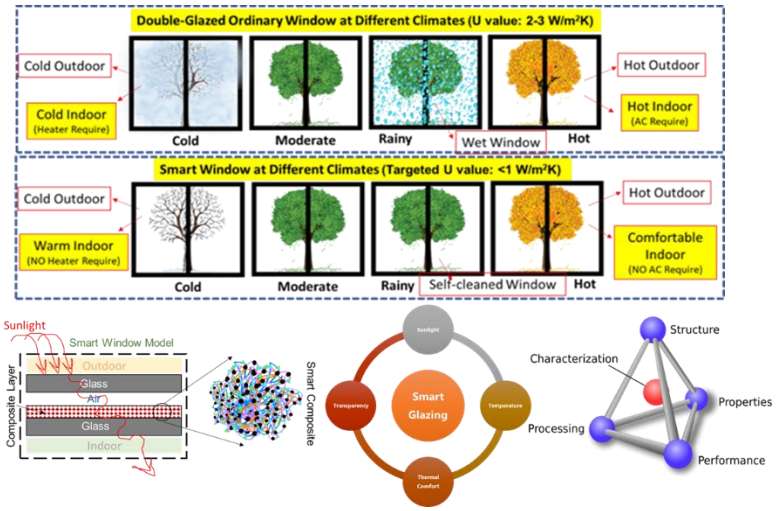

Figure 1. Schematic representation of the proposed work on the development of smart window composite technology.

The research program will focus on advancing glazing technology to achieve U-values as low as 0.4 W/m²K1, while concurrently enhancing indoor daylight environments and reducing annual energy consumption for buildings by 30-40%. This will be achieved through the development of a multifaceted smart composite material comprising optimized matrices of phase change materials (PCM) to augment thermal capacitance, transparent insulating materials (TIM) to enhance thermal resistance, transparent infrared absorbers (TIA) to absorb infrared radiation, and thermochromic

materials (TCM) to regulate light transmission.[1] Additionally, an infrared reflective coating will be employed to further mitigate heat loss and gain through the transparent building envelope.

The anticipated outcome of this research endeavour is the establishment of technological pathways toward the realization of energy-positive buildings in the UK. The primary objective of this ambitious project is to devise state-of-the-art technologies that empower end-users to reduce energy consumption while maintaining visual comfort and hygrometric well-being. This will be achieved through a combined approach encompassing theoretical modelling and experimental validation to develop and evaluate novel window and façade technologies based on smart composite materials, thus contributing directly to the advancement of advanced glazing technology and its potential to significantly reduce annual energy consumption for buildings.

Candidate requirements: Basic knowledge of chemistry, physics or nanotechnology.

Approximate Work Schedule in weeks (desk based/lab/report writing)

desk based -2 weeks

lab-5 weeks

report writing-1 week

[1] https://researchandinnovation.co.uk/smart-nanocomposites-revolution-for-energy-savings-windows/