



Harvesting solar energy via photothermal green technology for single-pane application

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Abstract:

The photothermal (PT) materials are capable of selectively absorbing solar light near the UV and NIR regions and efficiently convert it to heat. Upon coating the PT films on windows, the surface temperature can be effectively increased due to the photothermal effect. As the window surface temperature is raised relative to room temperature, the heat transfer at the window inner surface can be effectively reduced through the so-called optical thermal insulation (OTI) without any intervention medium. Based on this concept of OTI, a so-called “Green Window” has been designed for singlepane applications that meet the U-factor specifications of the US Department of Energy for colder regions of the world [1]. In this research, the “Green Window” is coated with thin films of chlorophyll and chlorophyllin retrieved from natural greens [2]. Both chlorophyll and chlorophyllin thin films are found to exhibit strong near UV and NIR absorptions and pronounced photothermal effects, while remaining highly transparent. Upon collecting solar light, considerable heat is created, effectively



raising the window surface temperature, leading to a reduced U-factor less than $1.7 \text{ W m}^{-2} \text{ K}^{-1}$ even below the values of double-panes. Based on these experimental results, we demonstrate a new concept of “optical thermal insulation” that lifts the dependence on insulating materials making single-pane window highly possible.

Biography:

Donglu Shi received his PhD in Engineering from the University of Massachusetts at Amherst. Upon graduation, he worked at Argonne National Laboratory for 8 years as a Staff Scientist carrying out research in the field of Electronic Materials. He is currently the Chair of the Materials Science and Engineering Program at University of Cincinnati. He is also an Adjunct Professor at the Institute for Biomedical Engineering and Nano Science at Tongji School of Medicine. He has published 270 SCI papers with an h-index of 46.

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