Catching the Sun with Transparent Solar Cells: Application of Natural Dye-Sensitized Solar Cells as BIPVs

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This study was conducted to extend the applications of Natural Dye-Sensitized Solar Cells (NDSSCs) to include transparent Building Integrated Photovoltaics (BIPVs), like solar windows. In Phase I, photosensitizing dyes, extracted from fruit and vegetable peels, were studied as an alternative to hazardous ruthenium complex dyes. In the current Phase II, red potato peel dye was used, as it yielded the best photovoltaic performance due to its high anthocyanin pigment content. With the aim of making the NDSSCs transparent, a process was engineered to replace the opaque graphite layer on the NDSSC positive electrode with PEDOT:PSS, a conductive polymer dispersion capable of producing transparent films. It was discovered and demonstrated that both film thickness and surface roughness of the PEDOT:PSS catalyst film effect the efficiency of an NDSSC. After catalyst layer optimization, the new positive electrode demonstrated 84% Visible Light Transmittance (Tvis), equally transparent as clear glass. The NDSSC produced had a 60% Tvis, which falls in the Tvis range of other windows in the market containing low-emissivity coatings, which minimize the amount of ultraviolet and infrared radiation transmitted through glass to decrease negative health effects and improve building energy efficiency. The NDSSC UV transmittance was 73% less than clear windows. Thus, the transparent NDSSCs fabricated would increase the available renewable energy production surfaces, while simultaneously blocking harmful radiation from transparent surfaces.

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