Investigation of Thin-Film Silver as Top Electrode Material for Transparent Organic Solar Cells

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Current installed area of “terrestrial photovoltaics,” such as rooftop solar panels, suffices only 1% of global energy demand. Transparent photovoltaics placed on the additional surface area of buildings (i.e. windows and siding) could double rooftop harvesting area and help humanity attain net-zero energy consumption. Researching materials for transparent solar cells (TSCs) can lower their cost while boosting their efficiency and thereby advance their technological promise. One challenge with developing TSCs is that the top conductive electrode is typically not transparent. This project investigated thin-film silver as a transparent and conductive material to serve as the top electrode of TSCs. Organic solar cells were fabricated with 80nm (control), 20nm and 12nm (thin-film) silver as the top electrode. Indium tin oxide (ITO) substrate was sonicated and plasma etched; zinc oxide was spin-coated onto the ITO. Active material poly(3-hexylthiophene) (P3HT):phenyl-C61-butyric acid methyl ester (PC61BM) was spin-coated and annealed. Lastly, molybdenum oxide was evaporated followed by deposition of silver. Device performance was tested with a solar simulator to examine power conversion efficiency. Peak efficiencies of 4.1%, 3.5%, and 2.2% were obtained for the 80, 20, and 12nm cells, resp., demonstrating working devices; the 20nm offers a good balance between performance and transmittance. A 4-point probe was used to test conductivity and a UV-Vis spectrophotometer to study transmittance; an inverse relationship was observed between conductivity and transmittance. Exploration of thin-film silver as an electrode for transparent organic solar cells can contribute to more versatile (i.e. printable and flexible), widespread photovoltaics and thus to a cleaner energy future.

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