

Organic Solar Cells and the Investigation of Non-Halogenated-Solvent-Processable Organic Photovoltaics

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In 2021, solar energy accounted for only 3.1% of the global energy demand while CO₂ emissions reached an all-time high of 36.3 billion tons. However, solar energy has the potential to completely satisfy the energy need of humanity. Organic photovoltaics (OPVs), which are solar cells based on organic compounds, can be made lightweight, flexible, transparent, and at low costs for solar energy, for solar-powered cars, textiles, and windows. Current organic solar cells use toxic halogenated solvents in manufacturing processes to dissolve the light absorption (active) layer. This project investigated the usage of greener, non-halogenated compounds as the active layer solvent. The non-halogenated solvents were tested for their ability to dissolve the active layer polymers such poly(3-hexylthiophene) (P3HT): phenyl-C61-butyric acid methyl ester (PC61BM) and for film morphology. Solar cells were fabricated in an inverted stack using solvents creating the best active layer. Indium tin oxide (ITO) substrates were cleaned by sonication and UV-ozone treatment. Zinc oxide and the active layer were spin-coated and annealed on the ITO substrate. Molybdenum trioxide followed by silver were then evaporated onto the solar cells using chemical vapor deposition. Cell performance was tested using a solar simulator at 1 sun intensity to determine their power conversion efficiency, fill factor, short-circuit current density, and open circuit voltage. Results from the best solvent showed properties close to that of the halogenated reference. Continued research and development into the usage of non-halogenated solvents will result in safer large-scale OPV manufacturing and therefore a greener future for the world.

Awards Won:

Florida Institute of Technology: Full Tuition Presidential Scholarship