Ultralight Weight, Thin Film Solar Cells on Plastic: Prospects for Organic and Single Crystal Inorganic Semiconductor Photovoltaics

Stephen Forrest

Departments of Electrical Engineering and Computer Science, and Physics
University of Michigan
Ann Arbor, MI 48109 USA

Until recently, low cost solar cells have been the nearly exclusive domain of Si or polycrystalline thin films of alloy semiconductors, such as CIGS or CdTe. Recently, however, these technologies have been challenged by new approaches to high performance, and low cost and the ability to be deposited or mounted onto flexible foils such as plastic or metal. One such technology, organic photovoltaics, is in its infancy, yet the progress in performance improvements has been dramatic, with results of >10% efficiency and lifetimes >10 years having been reported. The advantages of using organics for solar cells are several, including the very low cost, earth abundancy and non-toxicity of materials, low energy deposition techniques, and their compatibility with being deposited "by the mile" in a roll-to-roll manufacturing process. At the other end of the spectrum lie GaAs solar cells. Using our process of non-destructive epitaxial liftoff, a costly parent wafer can be used to support the growth of active solar cell epitaxial layers an indefinite number of times, transferring the epitaxy onto plastic foils for use in modules. Combined with their ability to achieve very high efficiency (the current record for GaAs solar cells is 28.8%), and their extreme flexibility when used in this lifted-off thin film form, GaAs is unexpectedly emerging as an important competitor to the more entrenched technologies. In this talk, I will discuss the technology challenges, and consider the prospects of both organic and GaAs solar cells as major sources of solar electricity.