Four-Terminal Solar Cell Based on High-Efficiency $Cu(In,Ga)Se_2$ Device on Metal Foil

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Copper indium gallium diselenide (CIGS) solar cells represent some of the highest efficiency thin-film cells (over 19% world record on small area cells). This, together with the ability to deposit the cells on lightweight substrates and relative radiation hardness makes CIGS cells ideal for space and high-altitude airship operation. HNEI, at the University of Hawaii, has developed an elemental 5 source co-evaporation system for deposition of Na-doped copper indium gallium diselenide (CIGS) films and fabrication of high efficiency solar cells on light weight metal foils. By monitoring substrate temperature rise to determine end point and with optimization of the sodium incorporation, a three-stage process was optimized for these substrates. A 3.9 cm^2 area solar cell was fabricated with an NREL-certified conversion efficiency of 14.0% (AM1.5 Global insolation). Preliminary calculations indicate that a novel four-terminal scheme incorporating CIGS and existing higher bandgap materials has the potential to increase efficiency beyond that of CIGS alone. In this paper, latest results for the CIGS solar cells and amorphous silicon-CIGS four terminal devices will be reported.

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