

Photolithography in Fabrication of Thin-film Solar Cells

Yusheng Zhu, Purdue University and Rakesh Agrawal, Purdue University

Solar energy has steadily increased its efficiency and cost-effectiveness throughout the past three decades and seems poised to compete with current primary energy (natural gas, oil, coal) as the need for alternative energy sources rises. One type of solar cell, thin-film cells, often relies on use of permanent photomasks in order to imprint a pattern onto the front metal contact. However, these machined metal masks are rigid and do not allow for different designs to be explored as current masks encounter difficulties in machining grids thin enough for optimization. Photolithography, traditionally used in the microfabrication field, provides a method in creating flexible and easily interchangeable designs to duplicate patterns onto solar cell contacts. First, a positive photoresist was spun onto a glass plate with a deposited conductor (ITO). Second, exposure of the photoresist was performed in a dark environment through near UV LEDs in order to polymerize the photoresist in accordance with the mask. Third, photoresist was developed and processed with a nickel/aluminum coating through an electron beam depositor. Parameters were optimized at each individual step of the procedure along with a variety of photoresist thicknesses and designs. Photomasks were printed on a laser-jet printer featuring grids of .5mm wide and produced clean copies of the masks with minimal walling. The implementation of photolithography in exploring more options to engineer more efficient inorganic solar cells hints at a promising future through its flexibility.