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Maskless Localized Electrochemical Deposition (LECD) for Solar Cell Production

Background

Many traditional approaches to deposition of metal materials, such as electroplating or sputtering, have the disadvantage of being non-selective additive manufacturing processes, which lead to additional processing steps and costs. For example, many approaches require masks to define the region where metal is to be deposited. Alternative metallization techniques have been sought in the field of solar cells, with the goal of reducing cost and increasing efficiency. Currently, a silver paste is deposited on the front of solar cells via a screen-printing process. To make the silver screen printable, organic additives and other materials are mixed in with the silver to create a viscous silver paste. The addition of these additives detracts from desirable properties of silver, such as high conductivity, and increases the resistivity of the paste.

Another method of patterned metal deposition is chemical electroplating, which involves little or no additives in the materials deposited, better preserving the benefits of a pure metal. In the chemical electroplating process, a metal is deposited in a near pure form onto the solar cell, resulting in a cheaper and lower-resistivity front contact than one created from silver paste. Electroplating is not a selective process, so it is necessary to add a mask layer on the surface of the solar cell to define the region to be plated. Depending on the resolution of the masking layer and the material used, this mask can be expensive and difficult to reproduce. The most commonly used masking process in research is photolithography due to the excellent resolution and high aspect ratios. However, the addition of photolithography substantially increases the price of the solar cells and makes some solar cell types unviable for production. Therefore, industry stands to benefit from an alternative plating process which circumvents the need for photolithography and reduces the cost of solar cell production lines.

Invention Description

Researchers at Arizona State University have developed a novel system for selectively electroplating a metal onto a surface, allowing patterned electrodeposition of a metal layer onto a cathode without the use of pre-deposition patterning steps. A cathode (material to be plated) is placed sufficiently close to an anode in a metal electrolyte chemical bath. Upon electrical activation in solution, the electric field created by the anode determines the locations of metal deposition, providing a localized deposition without need for photolithography or

other masking of the material to be plated.

Potential Applications

- Maskless chemical electroplating
- Solar cell production

Benefits and Advantages

- Circumvents the need for potentially expensive masking processes, reducing manufacturing costs and processing steps