**Gold Electrodeposition in Solar Cell Applications Research Report**

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The purpose of my research project was to analyze the procedure and use of gold electrodeposition for solar cell applications. The operation of solar cells produces what is called series resistance, a property that limits current flow and thus the efficiency of the solar cell. To improve the efficiency of the solar cell, an important factor is to reduce the series resistance. Series resistance is mainly composed of top-contact resistance and emitter resistance. Top-contact resistance from the top contact layer of the solar cell, which is patterned with grid “fingers” along the surface. Emitter resistance is concerned with the resistance produced as current travels from the solar cell body to the top contact layer. Therefore, to reduce series resistance, top-contact resistance and emitter resistance should be reduced.

First considering reducing finger resistance, since resistance is directly related to resistivity of a material and inversely related to the cross-sectional area of the material, the fingers should be made from materials with low resistivity and should have a greater cross-sectional area. Gold is a highly conductive material with low resistivity and is ideal for satisfying the first criteria. Second, to achieve a greater cross-sectional area, the finger should have a greater aspect ratio, which can be achieved by depositing – as from a cross-sectional point of view – a taller but thinner metal layer, ideally. The reason the layer should increase in height rather than width is covered in reducing emitter resistance. To reduce emitter resistance, the contact area between the solar cell body and the top contact layer should be greater. This can be achieved by a denser grid patterns. Dense grid patterns relate to the spacing of the fingers, so the thinner the fingers, the denser the grid pattern. Therefore, the reduction finger resistance and emitter resistance can be achieved by using materials like gold, depositing taller fingers, and decreasing the width of the finger cross-sectional area.

The next issue comes from the efficiency of the finger deposition process. Electrodeposition is a relatively inexpensive and efficient process. The process of gold electrodeposition is as follows. First, the solar cell is patterned and a “seed layer” is deposited by other deposition means. The seed layer is a thin layer of gold on the surface of the solar cell that functions as a template for the electrodeposition process. Since electrodeposition only occurs on areas where conduction is occurring, most of the gold used in the process with be deposited onto the seed layer. This is an improvement to traditional evaporation methods when only around half of the used material is deposited on the target site. This can reduce process costs since less material is needed for the same finger aspect ratio deposited. Thus, electrodeposition of gold has potential in solar cell applications.