Flexible, Low Cost Solar Cells Using High Efficiency Gallium Arsenide Compound Semiconductors

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GaAs photovoltaics are the most efficient but also the most expensive. If GaAs photovoltaics can be made on inexpensive metal substrates (cost $8/m^2) instead of GaAs wafers (cost $11,000/m^2), then it would be possible to achieve high-efficiency, low-cost solar cells. The purpose of this work was to determine the influence of antireflection coating, cell size and light concentration on the efficiency of GaAs photovoltaics on flexible metal substrates. GaAs solar cells of different sizes were fabricated on metal and wafer substrates using photolithography. ZnS/MgF2 was deposited as an antireflection coating (ARC). The efficiencies of all solar cells were determined from current-voltage characteristics at different light concentration levels (1 sun to 10 suns). After ARC, 180% improvement in conversion efficiency was observed in GaAs solar cells on metal substrates. At 1 sun intensity, the efficiency of these solar cells increased by 24% as the cell size was decreased from 1250 um to 500 um. When the light concentration was increased from 1 sun to 10 suns, the efficiency of these flexible cells increased by 14%. Power loss due to series resistance was found to influence the conversion efficiency at high light concentration levels. Overall, higher improvements in efficiency with antireflection coating, decreased cell size and higher light concentration were achieved in GaAs solar cells on flexible substrates than in cells on rigid wafer substrates. With further improvements, flexible GaAs solar cells can become an attractive technology to increase the use of solar energy, which is a cleaner way to produce electricity.

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