An Optimized Grid Design for a Sun-Concentrator Solar Cell

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Abstract—Two different collecting grid designs for a solar concentrator cell are considered: a simple linear grid pattern and an inverted square pattern. The grid dimensions of each pattern are optimized for maximum power output from the cell. The calculations show that the inverted square pattern is superior at all levels of concentration. Two methods of optimizing the square pattern are given, one of which allows the grid spacing to be a function of position across the cell face while the line thickness is kept constant. Detailed calculations are given for 100- and 300-sun concentrations.

1. Introduction

The design of the collecting-grid structure of a photovoltaic solar cell intended for use at high solar concentration levels is critical for maximum energy conversion efficiency. This is because the current density is so high that appreciable power is lost in the various parasitic resistances if the grid lines are too narrow or too widely spaced, while the grid shadowing of the sun is too large if the lines are wide and finely spaced. The problem clearly separates into two parts. The first is the choice of a grid pattern. There is no general mathematical method of predicting the best form, although Napoli et al. showed that a cross-hatched pattern of fine grid lines will always be poorer than a straight simple line grid (called here the linear structure). Therefore the choice must be based on intuition and general understanding. The second part of the problem is to optimize the chosen pattern so that the spacing, width, and thick-