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Optimization of gain and energy conversion efficiency using front-facing photovoltaic cell luminescent solar concentrator design MELISSA OSBORN, CARLEY CORRADO, Department of Physics, University of California, Santa Cruz, California 95064, SHIN WOEI LEOW, Jack Baskin School of Engineering, University of California, Santa Cruz, California 95064, EMORY CHAN, The Molecular Foundry, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, BEN BALABAN, SUE CARTER, Department of Physics, University of California, Santa Cruz, California 95064 — Luminescent solar concentrator (LSC) windows with front-facing photovoltaic (PV) cells were built and their gain and power efficiency were investigated. Conventional LSCs employ a photovoltaic (PV) cell that is placed on the edge of the LSC, facing inward. This paper describes a new design with the PV cells on the front-face allowing them to receive both direct solar irradiation and wave-guided photons emitted from a dye embedded in an acrylic sheet, which is optically coupled to the PV cells. Parameters investigated include the thickness of the waveguide, edge treatment of the window, cell width, and cell placement. The data allowed us to make projections that aided in designing windows for maximized overall efficiency. A gain in power of 2.2x over the PV cells alone was obtained with PV cell coverage of 5%, and a power conversion efficiency as high as 6.8% was obtained with a PV cell coverage of 31%. Balancing the trade-offs between gain and efficiency, the design with the lowest cost per watt attained a power efficiency of 3.8% and a gain of 1.6x.

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