Commercially viable solar energy is a critical part of meeting the energy needs of society while sustaining the environment. Concentrating Photovoltaics provide a capability to produce more power for a given area with a potentially lower cost. Dimpled light guide concentrators couple a large input area to a small strip of solar cell. Several of the advantages for this type of concentrator will be discussed. Following the pioneering work done earlier by Blair Unger, three new designs of dimpled light guide concentrator are presented, each with distinct advantages and drawbacks. Ray tracing models are described that illuminate the optical potential of each of these three design families. In addition to optical performance, lifetime and durability models are developed to inform material selection and cost modeling. Component parts of all three novel designs are measured and characterized. Three concentrator prototypes are fabricated and assembled into functional solar modules. The measured optical performance of these systems shows geometric concentrations ranging from 60x to 71x with optical efficiencies ranging from 19% to 33%. It is expected that this efficiency can be improved through well known processes in future iterations. In one of the designs, a small portion of the input aperture was found that coupled 89.6% of the light to the cell, demonstrating the potential for optical performance of future systems.
Planar micro-optic solar concentrator. Jason H. Karp, Eric J. Tremblay and Joseph E. Ford. Department of Electrical and Computer Engineering, University of California, San Diego 9500 Gilman Drive, La Jolla, CA 92093-0407, USA. *jkarp@ucsd.edu. Abstract: We present a new approach to solar concentration where sunlight collected by each lens in a two-dimensional lens array is coupled into a shared, planar waveguide using localized features placed at each lens focus. This geometry yields a thin, flat profile for moderate concentration systems which may be fabricated by low-cost roll manufacture.