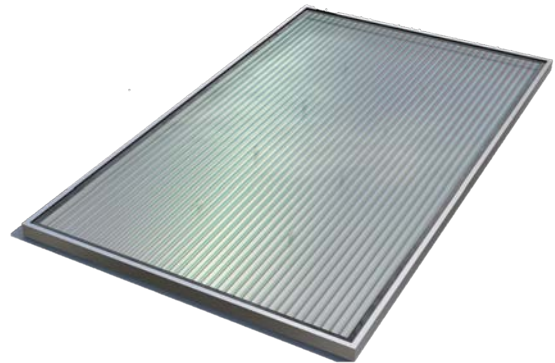


SOLARBANKERS

THE BRIGHT SIDE OF LIGHT

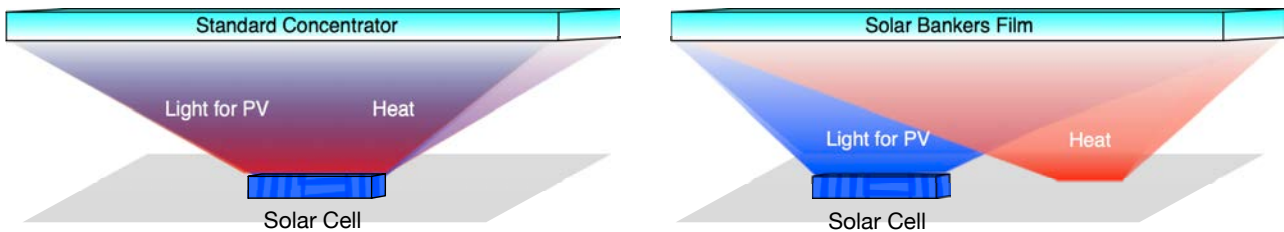


Solar Bankers offers unique solutions to maximize solar energy conversion in high-temperature environments. With its innovative modules and films, Solar Bankers guarantees higher in-field performance and lower maintenance than competitors, enabling to maximize returns on investment of solar projects. With its technical expertise and strong commitment to quality and innovation, Solar Bankers mission is to make solar energy affordable for everyone by offering custom-fit products that optimally adapt to different environments.

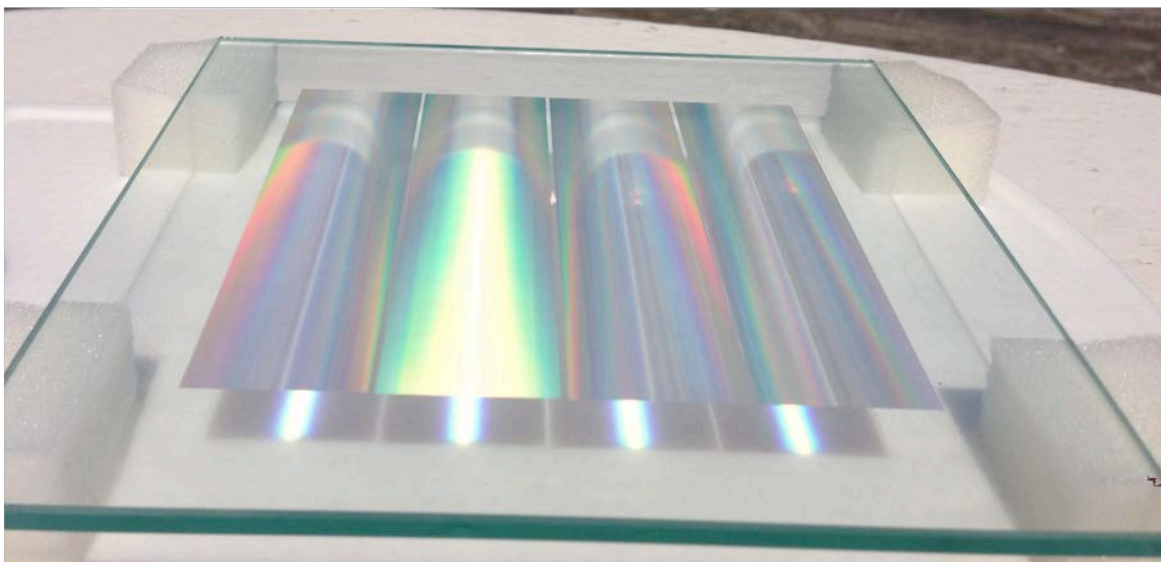


Solar Bankers Holographic Film

Solar Bankers holographic film manages the light in a smart way to achieve high light-to-electricity conversion efficiencies. The device is a micrometric-thick polymeric layer that concentrates the light and simultaneously separates its colors. The film separates the colors of light suitable for PV conversion from those that only cause panel overheating. The wavelengths suitable for PV conversion are focused on high efficiency silicon solar cells, while the heat (i.e. IR light) is dispersed away from the active converter. Differently from standard lenses, which concentrate the entire spectrum of light, Solar Bankers film enables enjoying the advantages of light concentration (higher light-to-electricity conversion efficiencies, smaller solar cell area) while drastically reducing its drawbacks (higher operative temperature).

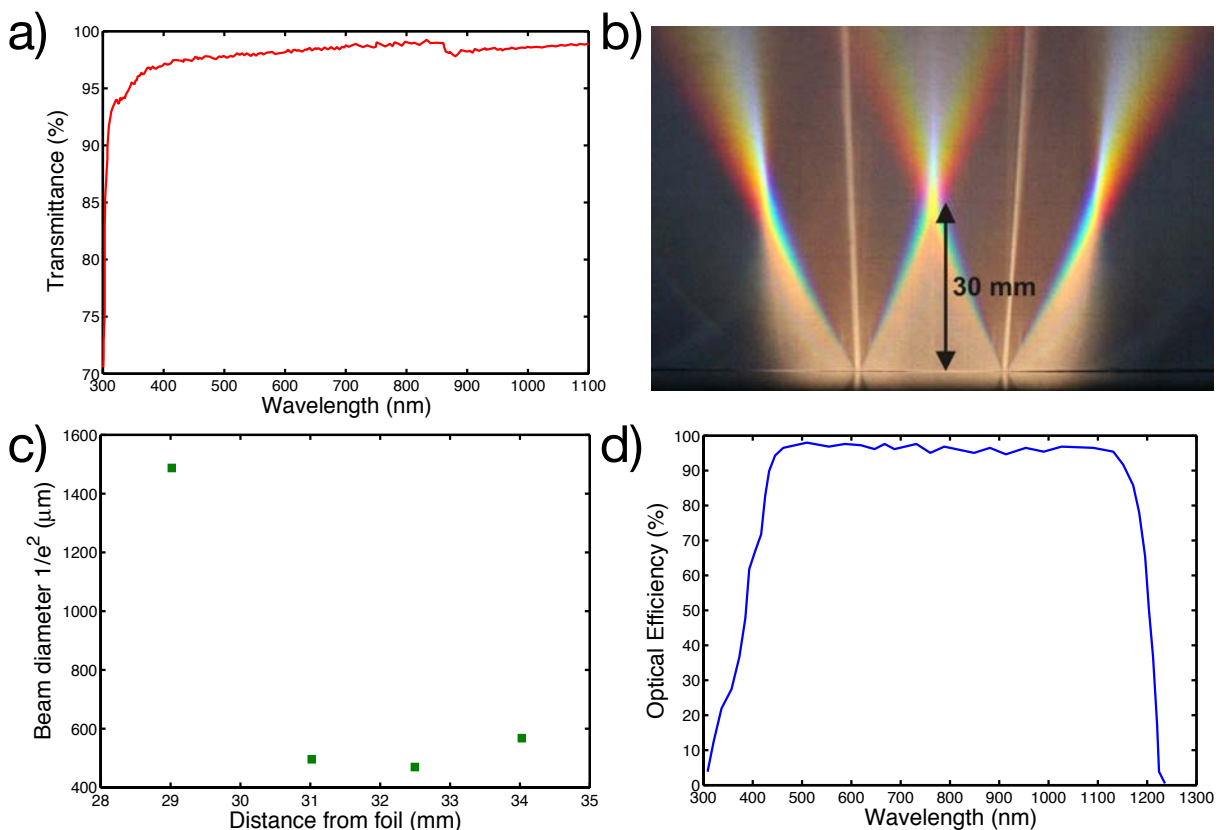


Solar Bankers film surface is patterned with nanometer-size steps that selectively interact with the different wavelengths of light, causing color separation. The foil is made of Poly(methyl methacrylate) (PMMA), a highly transparent and durable thermoplastic, and is printed on glass, which prevents from UV degradation by reflecting short wavelengths. The device is fabricated with a roll-to-roll imprinting machine, which consists of an imprint roller that transfers its nano-patterned surface onto a flexible substrate. Roll-to-roll imprinting enables large-scale and low-cost manufacturing: one machine can produce up to 20 m² per minute and production costs are very low as the imprint roller, which is the most expensive component, can be re-used for thousands of cycles.



Tests and Certifications

The optical properties of the optical film were tested by the Fraunhofer Center for Silicon Photovoltaics CSP. Fig. a below, which shows the transmittance of the device measured over the spectral range 300-1100 nm, reports an average value of 97.5%, meaning that the incoming light is almost entirely transmitted and that, therefore, optical losses are negligible. Fig. b shows a picture of the light pattern transmitted by the foil when illuminated with white light. Light beams are concentrated at a distance of approximately 3 cm, which is, by definition, the focal length of the device. To quantify such figure and determine the optical concentration factor of the device, the lateral size of the transmitted light pattern was measured at different distances, the results of which are shown in Fig. c. Using an initial spot size of 20 mm, a minimum beam diameter of 500 μm was obtained at 3.25 cm, corresponding to a maximum concentration factor of 40x. In order to investigate the spectral separation properties of the foil, the device was illuminated with a solar simulator and the spectral content of the first light beam (the one containing visible light) was measured at the focal plane. Fig. d, which reports the optical efficiency of the device, obtained normalizing the spectral irradiance of the transmitted light beam with that of the incoming light, shows a sharp spectral separation in correspondence of 1200 nm, with an in-band efficiency greater than 95%. This figure confirms the foil capability of selecting wavelengths suitable for PV conversion as Si solar cells can absorb only photons below 1200 nm. Finally, durability tests were carried out, proving that Solar Bankers optical film maintains 90% of its original transmittance for over 25 years, in accordance with standard solar module warranty.



a) Transmittance of the optical film measured in the spectral range 300-1100 nm; b) Picture of the light pattern transmitted by the optical film when illuminated with a white, halogen lamp; c) Diameter of the light beam transmitted by the optical film versus distance. The incident spot had a diameter of 20 mm; d) Optical Efficiency of the optical film measured in correspondence of the PV converter.