this loss is. Modern flat-facet, compression-molded lenses have an optical transmission of typically about 85%.

To date, the highest performance point-focus Fresnel lenses have been made only by compression molding. This results in a rather expensive product because of the long cycle times in the molding machine. Attempts at injection molding, which has a much shorter cycle time, have been disappointing. To the author's knowledge, little effort has been expended on Fresnel-lens development using recent plastic molding technology such as compression-injection molding. Significant improvements in performance and cost are likely possibilities with a concerted effort.

Entech has developed an innovative domed linear Fresnel lens illustrated in Figure 11.30. Because of the dome, the light is refracted upon entering the lens, and refracted again upon exiting. Many benefits are obtained by making the angle of the rays to the lens surface approximately the same as they enter and exit the lens. It can be shown that this condition minimizes reflection loss, minimizes chromatic aberration (spreading of the image for different wavelengths due to dispersion in the index of refraction), minimizes the effect of deflection in the lens, and minimizes the size of the focus. In addition, the draft region and tip radius can be outside the ray path, as seen in Figure 11.30. The transmission of a domed Fresnel lens can exceed 90%, close to the loss for a flat acrylic sheet alone [54].

One cost-effective method of producing Fresnel lenses has been 3M, and is called Lensfilm. In his method, a thin acrylic plastic sheet is molded by an embossed roller

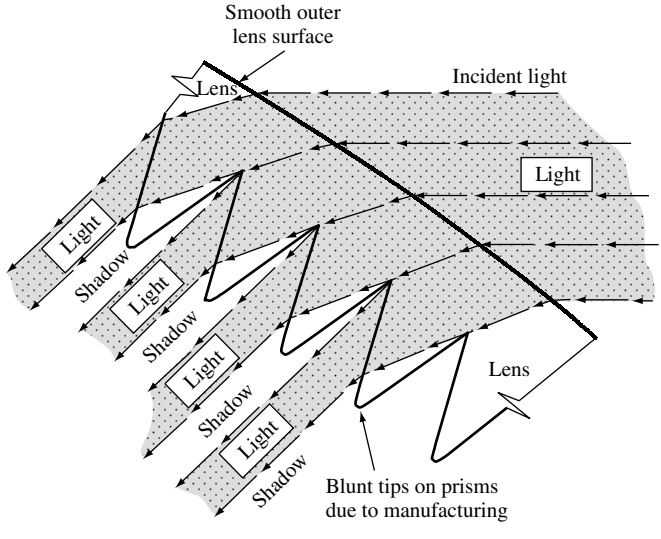

Figure 11.30 Cross section of the Entech domed Fresnel lens showing how the angle of incidence is nearly equal to the angle of exit, as well as how rays are shielded from the draft and the tip radius regions. Reproduced from O'Neill M, "Acrylic Extrusion/Embossing Process Development for the Low-Cost Production of Linear Fresnel Lenses", Presented at *Photovoltaic Concentrator Technology Development Project, Sixth Project Integration Meeting* (Albuquerque, NM, 1980) with permission by Sandia National Laboratories