The optical concentrator must withstand at least 20 years of outdoor weathering. It must also be cleanable in order to remove accumulated dust and grime. On top of this, it must meet cost targets and have good optical performance. These are difficult requirements.

For reflective surfaces, the only suitable material found to date is back-surface-silvered, low-iron glass. Glass is very durable and protects the silver surface from corrosion and damage. This has been well proven in the large LUZ solar thermal plants [66]. If the radius of curvature for the surface is less than about 10 m, then the glass must be sagged at high temperature to the desired shape (much as automobile windshields are manufactured), which adds to the cost. Many attempts at making reflectors of polymer film with deposited silver have been tried; however, to date none has had sufficient weatherability for commercial concentrator use. Anodized aluminum sheet is another option, but it has lower reflectance than silvered glass and questionable weatherability. Anodized aluminum can be used in the interior of modules, such as for SOEs, where it is protected from the weather.

The most common material for refractive lenses is acrylic plastic (PMMA).[17] When combined with UV stabilizers, acrylic has shown very good weatherability [67]. It has some disadvantages, however, which must be worked around. Chief among these is its large thermal expansion coefficient, low strength and stiffness, water absorption expansion, and susceptibility to scratches when cleaning with any method other than spray rinsing. Considerable effort has been expended on ways to bond thin acrylic lenses behind glass [68], but the large difference in expansion coefficients has stymied any solution. Another approach to realize the advantage of a glass front surface has involved the lamination of alternative materials to acrylic, particularly those with a low Young's modulus [30]. Recently, the idea of molding silicone rubber to glass has been revived [69]. This may be the ultimate solution for long-lasting Fresnel lenses that can be integrated into practical modules.

For point-focus SOEs, acrylic is unsuitable because the small amount of residual absorption causes the lens to overheat and melt. In this case, optical glass is needed. Quartz has been successfully used, but is expensive. Pyrex is cost-effective, but has too high an absorptance and overheats. Schott BK7 optical glass works well initially, but tends to solarize (turn purple) with exposure to the intense, concentrated light in a secondary [70]. Groups developing glass secondaries must work closely with glass suppliers to select the best glass with the best combination of cost, moldabiltiy, and resistance to solarizing.

11.5 CURRENT CONCENTRATOR ACTIVITIES

There are a number of groups working on concentrator PV systems around the world. This section outlines the diversity of this global effort. Only the larger, more well-funded activities are included. There are a number of small-scale, exploratory activities in addition to those discussed. The promise, quality, and vitality of research on concentrators will become apparent when reviewing the diversity and scope of this work.

[17] The only common optical plastics that are sufficiently stable under UV radiation in sunlight are acrylic plastic, Teflon, Tedlar, Tefzel, and silicone. Silicone cannot be used on an exterior surface.