Using optical index matching silicone gels to improve outdoor viewing and ruggedness of displays

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Portable computing, military environments, and demanding outdoor activities like fire rescue require a reliable and accurate display. Most commercial, off-the-shelf displays are not produced for direct viewing outdoors. The bright ambient light outdoors can cause high reflection losses and subsequently "display washout." Companies can increase display brightness, however this typically results in added power consumption and poor aspect ratios.

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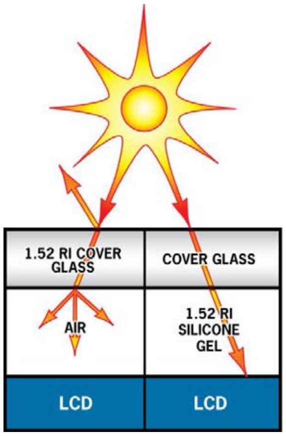
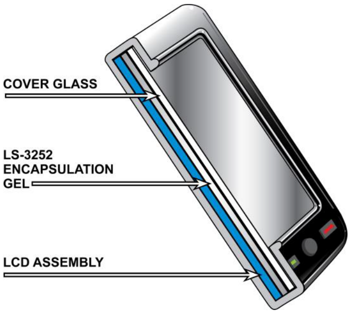
An alternative and growing trend is use of optical index matching silicone gels to reduce reflection losses and also aid in durability. Commercial displays typically have the display protected by a coverglass with a small air gap between the display and the coverglass (see Figure 1). This gap leads to reflection loss as much as 8.5%, dependent on the difference of refractive indices between the surfaces. This reflection loss can be decreased by filling the gap with an optical index matching silicone gel, thus greatly increasing viewing outdoors in bright ambient light.



These optical index matching silicone gels are especially designed for protection of sensitive photonics assemblies. The encapsulation materials help improve impact resistance and protect the assembly from dust and mechanical and thermal shock. Optical silicone gels are also transparent and their softness easily allows the LCD panel to be disassembled for rework.



There are several materials to choose from depending on the refractive index matching: 1.52 to match BK7 glass or 1.46 to match silica glass. In addition, these materials bond well to glass and other substrates used in the display.

Most optical silicones cure at room temperature within 24 hours, or heat can be used to accelerate the cure. Curing at lower temperatures minimizes stress on the display by reducing the thermal expansion between materials with different Coefficients of Thermal

Expansion (CTE). No UV exposure or temperature bake is required to initiate the cure process. These materials also remain fluid for at least eight hours. The long pot life and low viscosity enable the materials to wet out and fill in voids in complex assemblies and permit time for any trapped air bubbles to float to the surface and escape (see Table 1 for properties).

Epoxy and acrylate encapsulants have also found use for gap filling in displays. However, these materials' rigid nature causes cracking when thermally cycled and they yellow when exposed to UV light from the sun.

Properties	**LS-3246**	**LS-3252**
Uncured	**RI = Fused Silica Glass**	**RI = BK7 Silicate Glass**
Viscosity, cP	1000	425
RI, 589nm	1.46	1.52
Work Time, hr	8	6
Cure	**24 hr @ 25°C**	**24 hr @ 25°C**
Durometer,'00'	10	10
Operating Temp,°C	-115 to 200	-115 to 200

TABLE 1: Physical properties of optical silicone gels

These optical gels have specialized optical properties that allow them to provide the needed optical benefits for displays (see Figures 1-2).

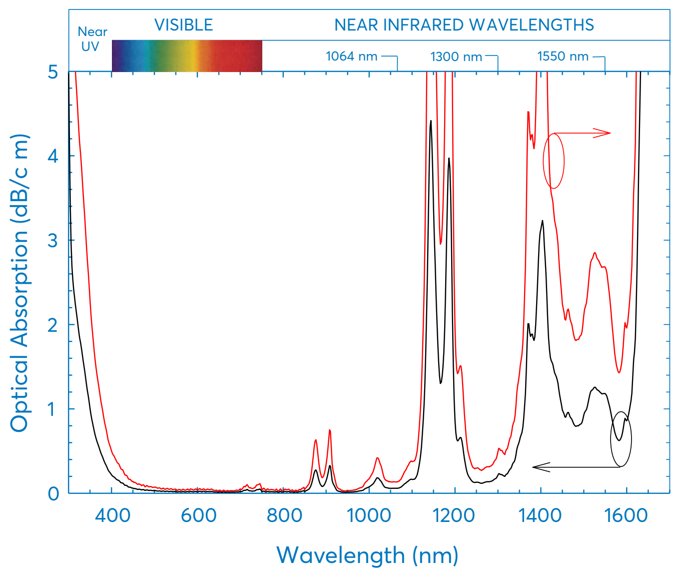


FIGURE 1: Optical Absorption vs. Wavelength

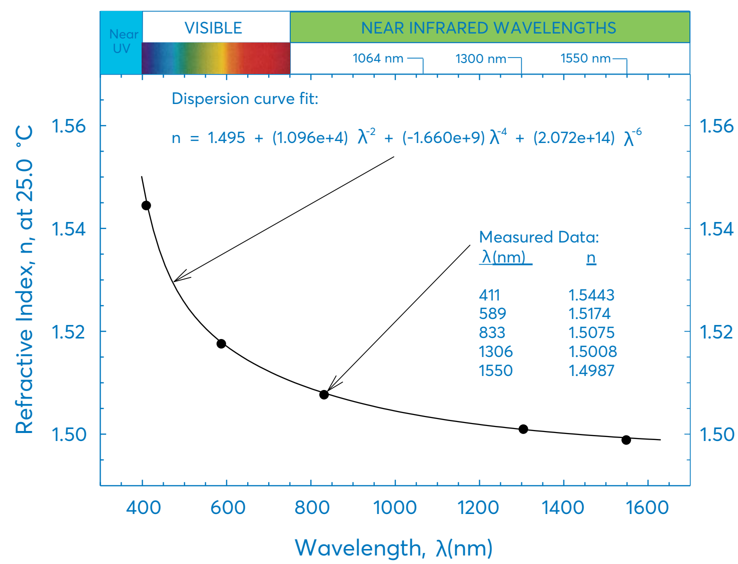


FIGURE 2: Refractive Index vs. Wavelength

In the future, touch screens will become more prevalent, creating further potential material demands to protect against hand oils, dirt and rain. These ever-changing challenges will keep the material scientist busy in the laboratory inventing the next generation of optical index matching silicone gels.

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