PCAP touch panels and optical bonding – A crystal clear solution

Larry Mozdzyn, Chief Technology Officer, Ocular

Optical bonding has been around in different capacities for many years and has recently gained new notoriety for the many benefits it brings to projective capacitive (PCAP) touch panel displays. Optically bonded displays, touch and otherwise, have increased in demand for a wide range of popular devices, starting with smartphones and tablet PCs, but also including ultra-thin television sets, laptop computers, large 3D displays and others.

The new generation of smartphones with PCAP touch displays and a gesturing interface showed system designers that an engaging and exciting user interface (UI) could stimulate demand beyond expectations. Now designers are finding out that in addition to improved optical performance and durability, an optically bonded PCAP touch panel also offers a host of other advantageous capabilities such as structural integrity, design flexibility, and enhanced functional and aesthetic properties as well.

Not your father’s lamination process

Faceplates of glass or other recommended materials have been laminated onto LCD displays for many years in order to increase durability or enhance readability in direct sunlight. Now, optically bonded PCAPs have taken the idea and expanded it into a more advanced process.

The clear adhesives that are used to optically bond PCAP displays must be applied with great precision to the entire surface of the layers that are being bonded together. Previous to the development of these adhesives, a manufacturer might utilize a gasket around the perimeter and create an air gap between the faceplate and touch panel, and between the touch panel and the display. The important advancement of optical bonding adhesives has been that they are optical adhesives, which means they are typically index matched to the other materials in the display to minimize or eliminate internal light reflections between material layers. Internal light reflections caused by different index of refractions will significantly reduce the readability of the display. By matching indices of refraction, the optical performance of the resulting display is greatly enhanced. (Figure 1a and 1b)

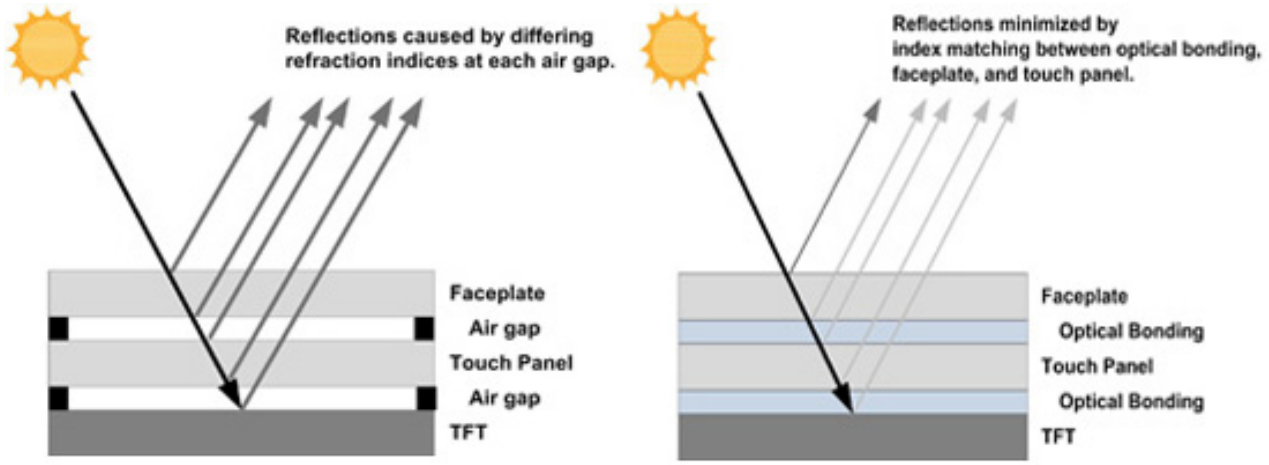

Figure 1: Previous to optical bonding, manufacturers might use a gasket around the edges of a display assembly, creating an air gap and significant light reflection from internal surface (1a). With optical bonding adhesives there are no air gaps and they are index matched to reduce reflections significantly, improving the readability of the display. (1b)

Optically bonded PCAPs

In a PCAP display, optical bonding might be employed twice: first to bond the PCAP touch panel to a display like a TFT LCD, and again to bond a protective layer of glass or another material to the touch surface. This surface will be subject to a great deal of wear and tear because it is the touch interface. Enhancing the durability and improving the display's resistance to scratching and shattering extends the life of the device. (Figure 3)

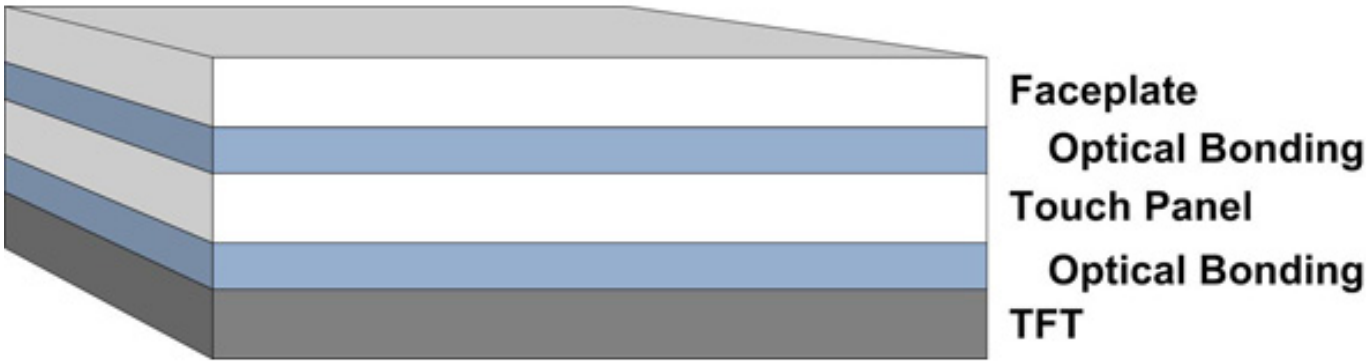

Figure 2: Optical bonding a projected capacitive touch panel typically involves inserting an optical adhesive between a faceplate and a touch panel, and between the touch panel and the display itself.

Aside from the improved optical performance, advanced optical bonding materials provide significant mechanical benefits as well. The addition of an adhesive layer between the touch screen and LCD surface can significantly improve product impact resistance. The optical bonding adhesive provides a "cushioning" layer that absorbs impact energy and improves overall durability and robustness. Improvements in the structural integrity of an optically bonded PCAP can improve overall mechanical strength of the entire device. In certain smartphones, for example, the device itself would not have the requisite structural robustness to meet the demands of everyday use if it were not for the mechanical strength of the smartphone's PCAP

display.

Ultimately, optically bonded PCAPs give system designers a degree of design flexibility not possible with other types of displays. In addition to flat coverplates, complex three-dimensional injection molded cover substrates can be optically bonded to touch panels and displays. Of course, when a complex construction like this is considered, strict design criteria must be followed to achieve acceptable quality standards.

Figure 3: In addition to improved optical performance, optical bonding gives system designers many other options including a aesthetically pleasing bezel-free look.

In addition to mechanical characteristics, the sleek, contemporary styling of many smartphones and tablet PCs would not be possible without the bezel-free look and feel of optically bonded PCAP displays. This is especially true in consumer markets where fashion is as potent a driver of user demand as function. The aesthetic qualities of bezel-free PCAP displays and the design freedoms that they bring to the design team cannot be undervalued.

Whenever a cover substrate is optically bonded to a PCAP touch panel the design team must also consider the performance requirements of the touch panel itself. The panel’s ability to accurately sense individual touches as well as complex

gestures is critical to the overall operation of the system. A layer of adhesive between the touch panel and a protective coverplate can reduce panel sensitivity if improperly selected. As a result, the characteristics of the adhesive, the thickness of its application in the finished product and the flatness of the substrates are critical to the performance of the touch panel.

Another interesting aspect which has emerged is the ability to repair and refurbish devices which have optically bonded PCAP displays. Previously it was thought that optically bonded displays were difficult to repair. This can be a major concern for handheld mobile consumer devices which are often accidentally dropped or left somewhere where they might be damaged. Now, advanced next-generation optical adhesives can allow the component parts of a damaged optically bonded display to be separated, cleaned and either repaired, replaced or refurbished.

Bonding time for PCAPs

Advances in PCAP technology, new performance parameters for optical adhesives and improvements in the manufacturing equipment that is used in high-volume optical bonding fabrication processes are all contributing to greater adoption by the industry.

Whereas in the past, the process for effectively bonding PCAP displays with optical adhesives may have been limited by display size and the thickness of the adhesive, now such restrictions have been lifted. Bonded display sizes can be as small as two inches diagonally or as large as 82 inches. And adhesives can be applied with high quality results in thicknesses ranging from 50 microns to five millimeters.

Over the last few years, smartphones and tablet PCs may have demonstrated to the marketplace that users are attracted to the functionality and styling of devices with optically bonded PCAP displays. The effects of an engaging UI enabled by PCAPs and assembled with optical bonding are being felt throughout the industry. New applications for optically bonded PCAP displays are emerging every day, such as medical diagnostic and monitoring systems, point-of-sale (POS) terminals, GPS systems, industrial control applications and many others. PCAP displays benefitting from optical bonding are clearly becoming the user interface of choice.