

APPLICATION NOTE

Microhardness tester for quality control of LCD spacers

Two substrates, thin film transistor (TFT) arrays and colour filters, are common components of liquid crystal display (LCD) panels. Spacers are used to keep the gap between them consistent, so that the liquid crystal material can be injected evenly inside to “do its magic”. The mechanical properties of these spacers exert great influence on the finished display’s robustness and image quality.

The most common kinds of spacers used in TFT LCDs are bead (spherical) and column (patterned by lithography) type spacers. The collapse strength, recovery rate and height uniformity of those spacers play a major role in keeping the gap stable and, thus, the panel in good condition.

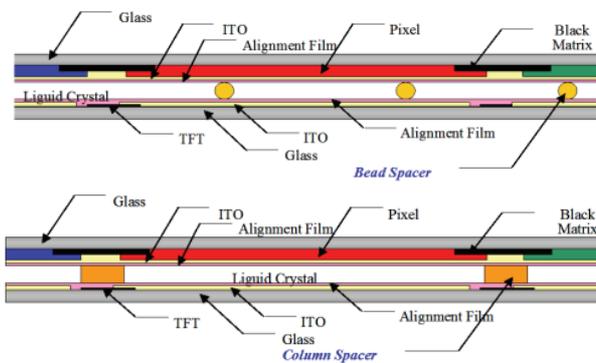


Fig. 1: Bead spacers and column spacers

Strong spacers will keep the gap in good shape even under severe outside impact, while higher recovery rate means less permanent damage from those impacts. On the other hand, better height homogeneity of spacers will lead to faster response time, wider viewing angle, higher resolution and contrast ratio of the display. It is therefore important to monitor and control those parameters when manufacturing LCDs.

By compressing and releasing the spacers with the FISCHERSCOPE[®] HM2000 microhardness tester, these critical mechanical properties can be precisely measured. For this purpose, a special indenter with a flat tip is used instead of the typical Vickers pyramid, as illustrated in Figure 2.

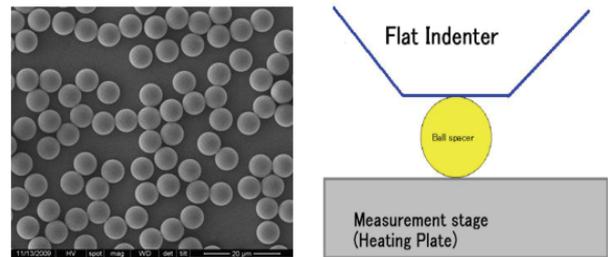


Fig. 2: SEM (scanning electron microscopy) image of bead spacer and the illustration of measurement with FISCHERSCOPE HM2000 and a flat indenter

Depending on the force applied to depress the spacer, different parameters can be monitored. With a relatively high force, the collapse strength of the spacer can be tested, while lower load levels are used to determine the recovery rate.

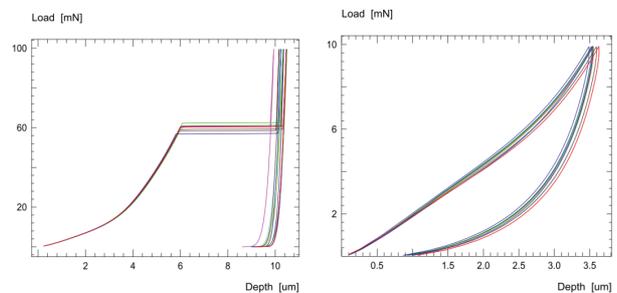


Fig. 3a: Measurements on 10 bead spacers with max. load of 100 mN. The plateau indicates the collapse strength of the tested balls, while the vertical lines show spacer diameters.

Fig. 3b: Measurements on 10 bead spacers with max. load of 10 mN. The residual displacement divided by total displacement can be considered the recovery rate.

The FISCHERSCOPE[®] HM2000 is the ideal choice for measuring the mechanical properties of LCD spacers. Equipped with a flat-tip indenter, highly sensitive force control and displacement sensors, as well as a precise sample stage, the characteristics of each individual spacer can be determined in a single testing cycle. For further information please contact your local FISCHER representative.