

# Trend of Wide Viewing Angle Technology

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## Abstract

We compared various LCD modes for wide viewing angle. These modes can be classified as film-compensation, multi-domain, IPS. So far, IPS and multi-domain VA represent best performance. The performance gap with respect to CRT is diminishing.

## Introduction

LCD that was used primarily in small size display and notebook, is expanding the range of its application. Recently, LCD monitor was successfully introduced and CRT and LCD started to compete at this market. Some LCD maker is trying to start new market of LCD TV. However, performance of LCD still lags behind in many respects. How to reduce this gap is difficult challenge that LCD makers should overcome.

Viewing angle is a specification that is traditionally considered

Market Size

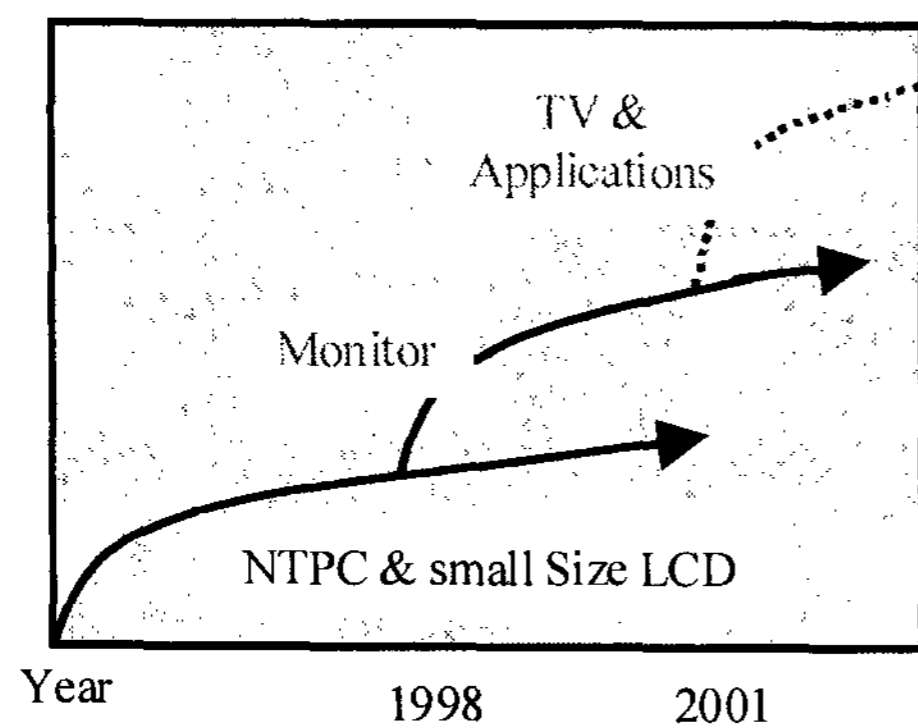


Fig.1 LCD market Trend

as one of the weakest points of LCD compared to CRT. Various ideas have been suggested to remedy this weak point. In this paper we will review and compare the working principle and the characteristics of various LCD modes, focusing on viewing angle characteristic.

## Classification of LCD modes

Simple way of making wider viewing angle is using compensation films. Anisotropic film that optically compensates unwanted optical anisotropy of LC molecule, is added on the substrate of LC panel. As newer films are designed, wider viewing angle is obtained. This method is easy to apply and can be combined with other wide viewing angle technology. OCB mode has self-compensating structure inside the cell. - The alignment of LC molecule near the upper and the lower substrate compensates one another. In LCD mode using nematic LC, OCB is the fastest mode. So film-compensated OCB mode has quite high potential for the multimedia application.

Another method is using multi-domain of LC itself to optically compensate anisotropy of LC cell. This method can be applied to TN, vertically aligned mode and horizontally aligned mode. Configuration of two domain or four domain is most effective. Compensation film is generally added to improve the

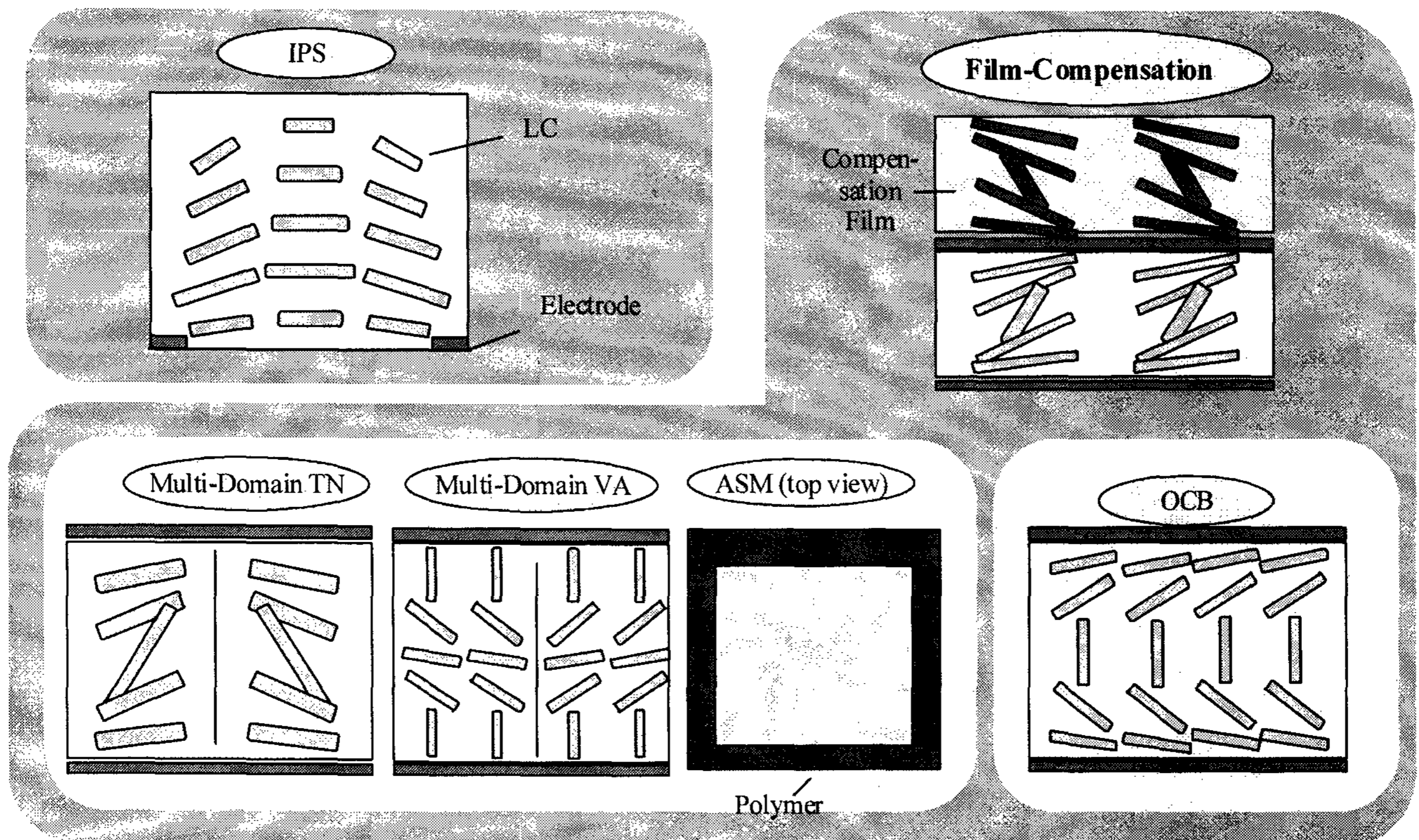


Fig.2 Wide viewing angle LCD mode ( OCB : Optically Compensated Bend , IPS : In-Plane Switching, ASM : Axially Symmetric Aligned Microcell, VA : Vertical Alignment )

viewing angle characteristics. How to make multi-domain effectively is the main interest for this method. Multiple rubbing and UV alignment were suggested for TN and VA. These days, patterning of electrode and/or rib formation are gaining much attention for multi-domain VA. In ASM mode, making polymer walls inside LC cell is proposed.

In LC modes mentioned above, LC molecule moves between vertical and horizontal position. When LC molecule move only on the horizontal plane, wide viewing angle can be obtained. IPS and FLC are the modes which use such configurations. In IPS mode two electrodes of opposite sign are made on the lower substrate and LC molecules align along horizontal electric field. In FLC, LC molecule moves on two horizontal positions. These modes do not need compensation film.

### Comparison of various modes

The general performances of various modes are shown in Fig.3. Performance of the same mode may differ slightly due to the difference of optimization of cell parameters. In selecting mode, other factors such as response time, productivity should be considered.

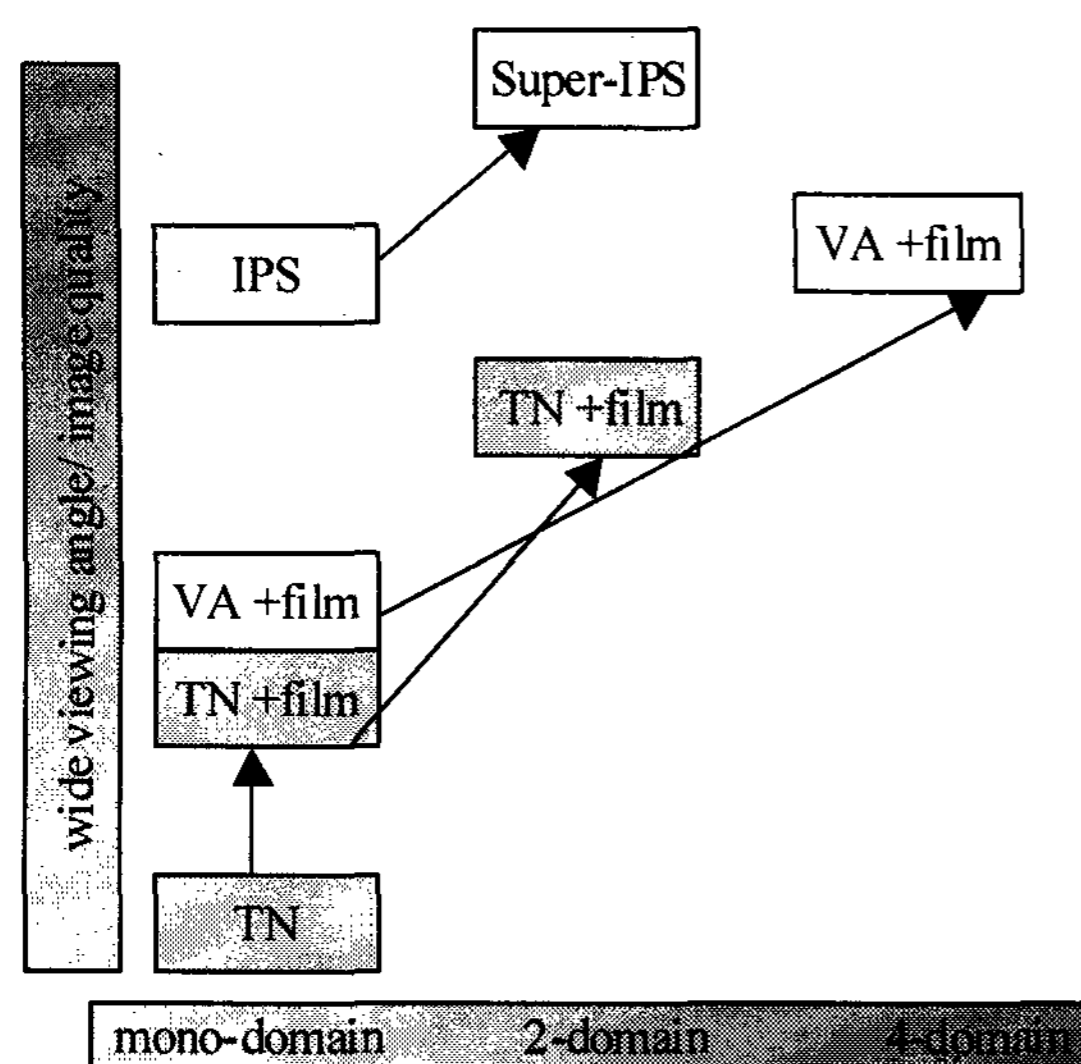


Fig.3 Performance of LCD modes

Until now, multi domain VA and IPS are most promising technology. In multi-domain VA mode, the largest number of necessary domain division is four. As sub pixel of LCD is not square, four domains of different areas are generally constructed. The major difference among VA mode such as MVA, PVA and Para-A is the method of making multi domain structure. In IPS mode, pixel structures of IPS of various companies were mostly similar. This year, Hitachi proposed super-IPS that uses electrode of zigzag pattern, solving some shortcomings of IPS mode.

### Conclusion

Various ideas have been suggested to make high performance LCD comparable to CRT. The performance gap still remains, though the difference is decreasing by the introduction of new ideas and efforts by various people.