

A novel anti-glare layer on a polarizer for better image and durability

J.H. Lee*, H J Kim, C.H. Park, K.S. Kwon, H.C. Choi, I.B. Kang

Panel Development Division, LG.Philips LCD
642-3, Jinpyung-dong, Gumi-city, Kyungbuk, 730-350, Korea

Abstract

We developed new anti-glare(AG) layer which has improved image quality and solved mechanical problems. Conventional silica-type AG has some restrictions related to sparkling, causing mechanical defects. The new anti-glare layer is designed with adjusted optical factors and polymer type. Therefore new anti-glare layer meets two main characteristics at once using unmatched optical property between scattering in material and surrounding.

Introduction

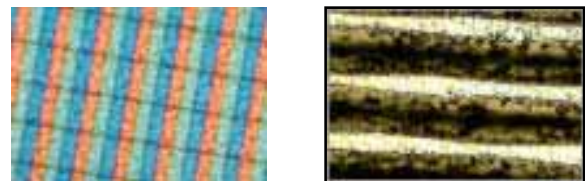
Anti-Glare (AG) made from Silica or Polymer-type bead, which disperses surface-reflected light and controls the direct reflection of outside light, has been inserted to prevent the reflection and improve image quality. However, following sparkling occurrence in high-resolution models and attrition problems between system constructions that appear in the enhanced vibration test, the conventional AG type is no longer enough to solve those problems. LPL has developed the new Anti-Glare polarizer, which is suitable for high resolution and mobility.

Surface Treatment

1. Conventional Surface Treatment

Silica bead or polymer bead are usually used for surface coating in Anti-Glare type. When silica type is applied, sparkling problems in upper polarizer and

grinding phenomenon, which results from the attrition between a down polarizer and backlight sheets occurs (Figure 1). Problems such as sparkling and grinding between sheets do not happen in polymer type but luminance decrease occurs due to high haze processing compared to silica type.



(a) Sparkling Problem (b) Grinding Problem

Figure 1. Conventional Surface Treatment problem

2. Novel Surface Treatment

2-1. Visibility quality improvement

High haze treatment is required to reduce sparkling. However, that causes side effects like white muddiness and low luminance (figure 2).

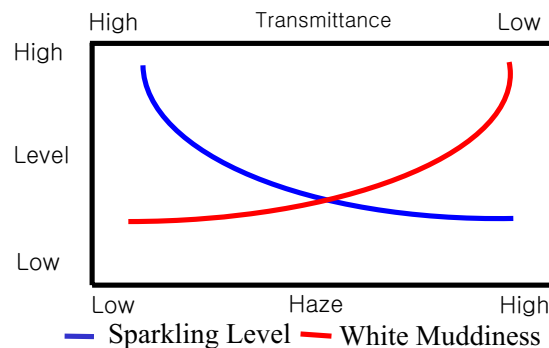


Figure 2. Visibility of Surface Treatment
New AG considered visibility as a special quality.

As a result New AG applied surface processing in which Sparkling Level, White Muddiness, and luminance are optimized.

■ Sparkling Level & White Muddiness improvement:

New AG regulated polarizer's surface coating roughness to lower white Muddiness and sparkling Level.

- Rz¹⁾ Tuning

We evaluated sparkling Level by Rz's height. Because Rz's height is low, sparkling level became low. New AG regulates Rz's height and make sparkling level optimized.

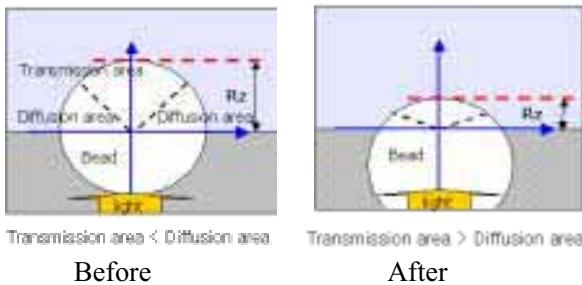


Figure 3. Rz's tuning for sparkling improvement

Light which passes through beads is divided by A area(transmission area) and B area(diffusion area). There is brightness difference between A area and b area caused by sparkling. We expanded A area to reduce brightness difference. So, we could make sparkling level low.

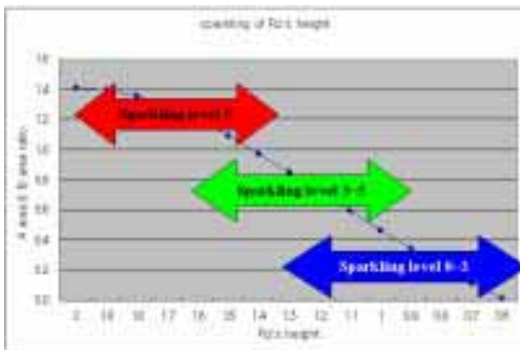


Figure 4. Sparkling Level of Rz's height

X axis in Rz's height and Y axis is 2B/A(A area and B area ratio).

- Sm²⁾ Tuning

We evaluated sparkling and White Muddiness level by Sm's interval regulation. If Sm becomes low, sparkling level becomes low, although White Muddiness rises.

Therefore, we have regulated Sm and found the condition, in which sparkling level and White Muddiness become low. New AG regulates Sm, so we applied the condition where sparkling level and White Muddiness become optimized.

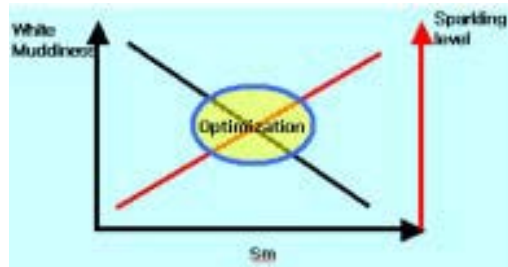


Figure 5. Sparkling & White muddiness level of Sm's length

■ Luminance improvement:

New AG uses dispersant and regulates Polymer Type Bead interval. It reduces luminance by interior Haze, exterior Haze and elevated rectilinear anger of light.

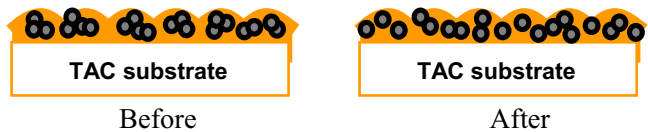


Figure 5. Luminance Improvement

2-2. Mechanical characteristics improvement

New AG regulated Polarizer's Surface Coating roughness and changed materials, reducing Grinding Problem.

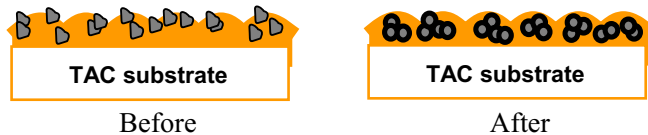


Figure 6. Mechanical problem improvement

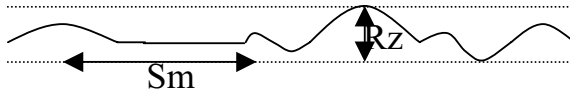
Term

SID Tech. Digest, P 408(2001)

Ra : International parameter of roughness. The arithmetic mean of the departures of profile from the mean line

Rz¹⁾ : The average height difference between the five highest peaks and the lowest valleys within the sampling length

Sm²⁾ : The mean spacing between profile peaks at the mean line



Summary

Because of high image quality of liquid crystal display and mobility emphasis, suitable Polarizer Surface treatment is necessary. So we developed a new AG polarizer of which visibility is superior and mobility is strong.

Item	Coventional AG (Silica)	Coventional AG (Polymer)	Novel New AG
Sparkling	△	○	○
White Muddiness	○	△	○
Luminance	○	△	○
Grinding level	△	○	○

References

- [1] Method and apparatus for quantitatively evaluating Scintillation, antiglare film and method of producing the same Patent No: US 6,577,756 B1 Date of Patent: Jun.10, 2003
- [2] Ichiro Amimori, Naohiro Matsunaga, Tsutomu Arai, Hiroyuki Mori, Yukio Shinagawa "Image analysis of high-definition LCDs with AG" SID Tech. Digest, P 838(2002)
Films by Novel Ray tracing simulation
- [3] Ichiro Amimori, Naohiro Matsunaga, Tsutomu Arai, Hiroyuki Mori, Yukio Shinagawa "New Method of optimizing AG properties for High-Definition LCDs Using Ray Tracing Simulation"