Special AR coating

Totoku's new *Special AR Coating technology addresses properties of focus, noise reduction, contrast, and viewing angle achieving film-like black and accurate reproduction of images. In this paper, we describe its features and physical measurement results.

* Patent pending

Conventional LCD surface treatment

To reduce background appearances on the screen by reflection, the surface of medical displays is generally Anti-Glare (AG) coated. However, the AG coating causes focus loss due to diffused reflection and increased noise because of the diffused light that overlaps with the displayed images. For this reason, some displays used in diagnostic imaging require such finite depiction, that radiologists prefer a non-AG coated display, sacrificing reflective benefits, but gaining a crisper image.
Proper focus and noise properties conflict with reduction of specular reflection, and a development of an LCD surface treatment that meets the both demand was desired.

Special AR Coating

The special Anti-Reflection (AR) coating is a surface treatment that provides AR layers directly on a LCD panel as shown in Fig. 1.
Fig. 2 shows comparison of micro bright points displayed on the special AR-coated LCD and the AG-coated LCD. Due to the reduced diffused reflection by the special AR coating, the bright point is displayed more clearly with the improved focus and contrast compared to the one on the AG-coated LCD.

Physical measurement results of the display properties

Table 1 shows physical measurement results of the display properties. The special AR-coating obtained the best results in the three surface treatments for all the measurement items except for the specular reflection (Rs).

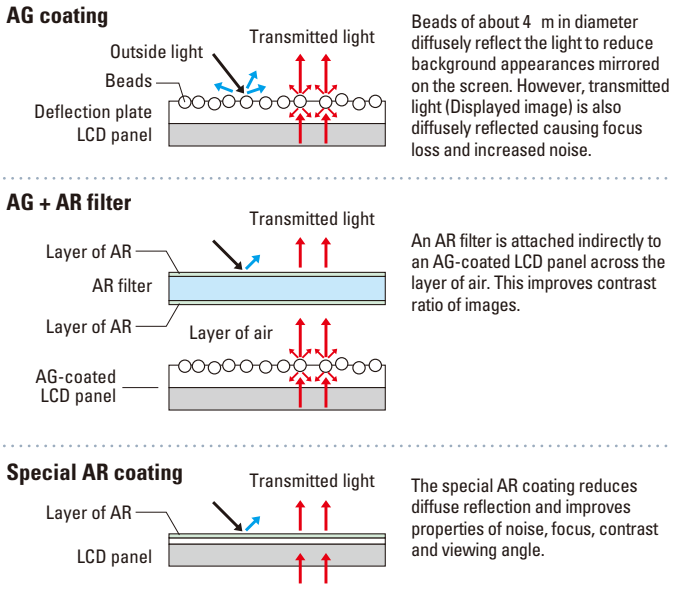

Fig. 1 Mechanism and features of each LCD surface treatment

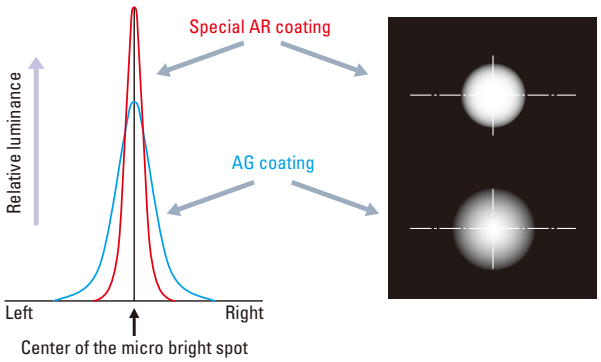

Fig. 2 Illustration of the displayed micro bright points

Table 1 Measurement results in each surface treatment

Surface treatment \ Measurement item	Focus (MTF)		Noise (NPS characteristics)	Max. luminance (Dark room)	Min. luminance (Lighted room)	Contrast ratio		Reflection coefficient		*Viewing angle (Left - Right)	
	Horizontal	Vertical				Dark room	Lighted room	Rs (Specular)	Rd (Diffuse)	Lighted room	Dark room
Special AR coating	105	104	Refer to Fig. 4	105	107	117	110	90	257	60°~ 60°	80°~ 80°
AG + AR filter	100	100		100	100	100	100	100	100	0°~ 10°	60°~ 60°
AG coating	99.7	98.3		99.2	—	91.2	—	113	94.7	—	60°~ 60°

Note:
• A 3MP display was used in the measurement
• The measurement was performed in a relative manner where AG + AR filter is 100. (The bigger values indicate the better properties.)
*The viewing angle was measured in accordance with AAPM TG18. (The specified viewing angles indicate where the contrast ratio of over 170 is achieved.)

Details of major measurements

◆ Luminance characteristics in a lighted room

The special AR coating achieved better viewing angle, contrast characteristics and lower minimum luminance compared to the AG + AR filter.

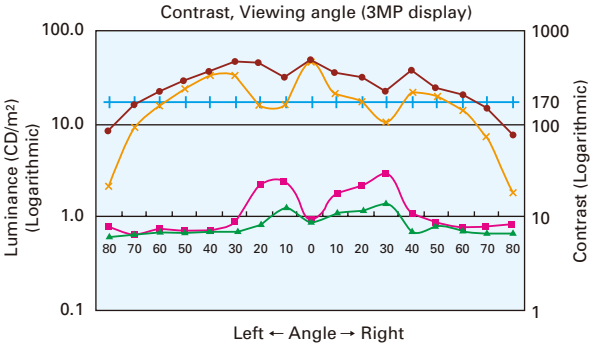

Fig.3
Luminance characteristics in the lighted room

- Min. luminance of AG + AR filter
- Min. luminance of special AR coating
- Contrast of AG + AR filter
- Contrast of special AR coating
- AAPM-P

◆ Specular reflection characteristics

Fig. 6 shows photographs of each LCD with 4 different surface treatments reflecting the background in the lighted room. Fig. 7 shows image analysis of the photographs in Fig. 6. The X-axis represents the horizontal direction in the photographs and the Y-axis represents relative luminance.

A piece of white paper was placed in front of the surface of each LCD panel to take a photo of its appearance on the screen by reflection.

Although the paper edge appears more clearly on the special AR-coated LCD than the AG-coated LCD or the AG-coated LCD with the AR filter, as shown in Fig. 7, relative luminance of the special AR-coated LCD is lowest. Conversely, the white paper appears most clearly on the mirror-shiny surface of the *Glare type LCD, and its relative luminance is the highest of all LCDs.

*Non-AG-coated LCD panel to improve the noise and the focus properties.

Conclusion:

The special AR-coating obtained the best results in the three surface treatments for all the testing items except for the specular reflection (Rs). Although the reflection coefficient in the specular reflection is slightly lower than the others, as shown in Fig. 7, the special AR-coated LCD achieves the lowest relative luminance of the reflected image.
For these reasons, it was indicated that the special AR-coating is the surface treatment best suited for medical displays.

◆ Noise characteristics (NPS characteristics)

The noise level of the special AR coating is lower than the AG coating.

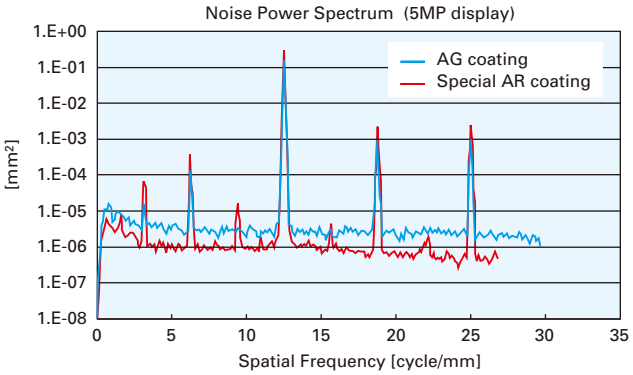

Fig.4 Noise characteristics

◆ Focus (MTF characteristics)

The special AR coating achieved the higher focus properties than the AG coating.

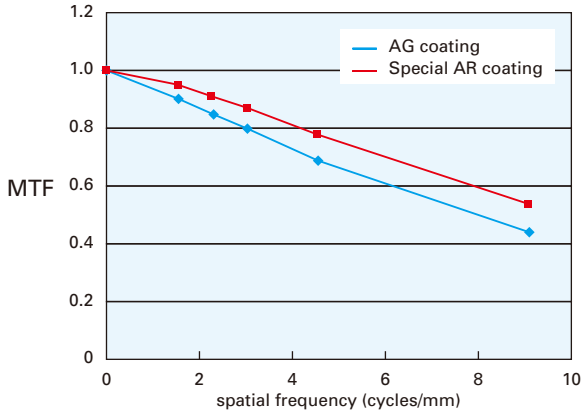

Fig.5 Focus characteristics measured by 5MP display

Photos of the LCD surfaces reflecting a piece of white paper

Fig.6 Comparison of the background reflected on the screen in the lighted room

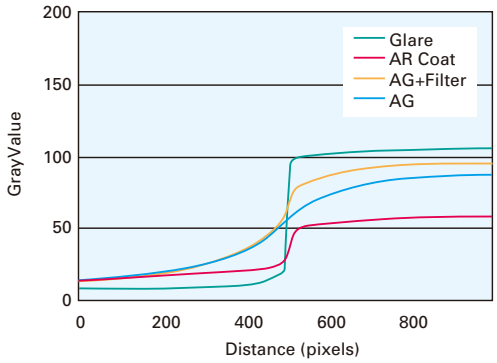

Fig.7 Graph of the photograph analysis

http://www.totoku.co.jp/display/

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