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Grounding Design to Prevent Electrostatic Accumulation in Foldable Displays

Jaewon Choi

Chang Ju Kang

Tseng Chun

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ABSTRACT

In traditional polymer organic light emitting diode (P-OLED) displays, electrostatic charge buildup can occur near the edge of the display, leading to abnormalities such as green flashes, vertical crosstalk, or a greenish display. To mitigate this problem, a discharge path is established to release electrostatic charges by using silver dotting on the edge of the display that connects to a conductive black matrix and provides a grounding path. However, for foldable displays, the silver dotting can crack due to the movement and sliding of different layers as the device is folded and unfolded, causing disconnection from ground. This disclosure describes a foldable display that implements an electrostatic discharge path as a grounding mechanism to avoid electrostatic charge accumulation at the edge of the display. The grounding design includes silver printing on the trim area of the device that is linked to a conductive pressure sensitive adhesive (PSA) to release the electrostatic charge via the device enclosure.

KEYWORDS

- Electrostatic accumulation
- Foldable display
- Electrostatic discharge (ESD)
- ESD protection
- Silver printing
- Pressure sensitive adhesive (PSA)
- Ag printing
- Conductive adhesive

BACKGROUND

Foldable displays are used in electronic devices such as foldable smartphones. Electrostatic charge accumulation in foldable displays can lead to various display abnormalities like green flashes, vertical crosstalk, and/or a greenish display.

In traditional polymer organic light emitting diode (P-OLED) displays, a discharge path is established to release electrostatic charges and prevent their buildup at the edge of the display. This discharge path connects a conductive black matrix (BM) ink to a copper foil , ultimately grounding it to a ground terminal using a silver-dotting (Ag-dotting) process.

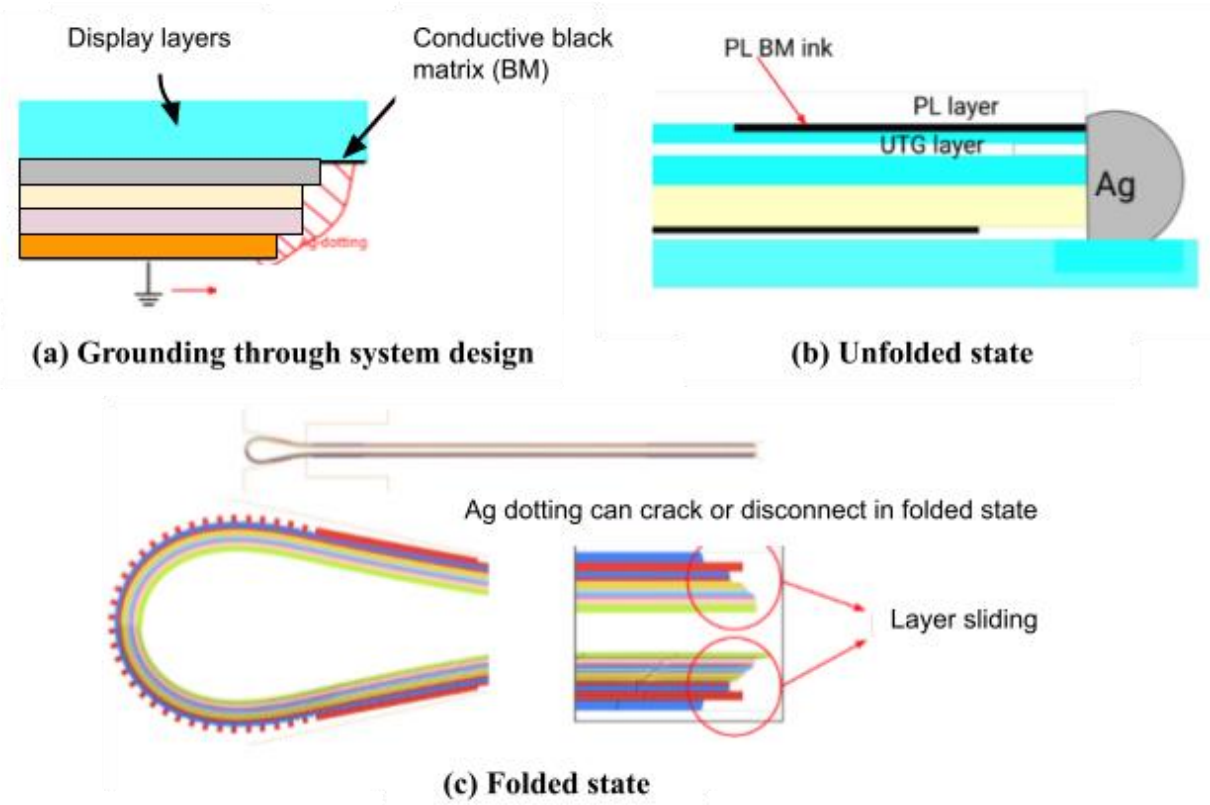

Fig. 1: Problems with grounding design for foldable devices

Fig. 1 illustrates problems with grounding design for foldable devices. Fig. 1(a) shows conventional grounding through system design. Silver dotting couples the various layers of the

display to a system ground to reduce or eliminate electrostatic charge accumulation. In an unfolded state, as shown in Fig. 1(b), the layers - the ultrathin glass (UTG) layer and the PL layer - are grounded via the silver dotting and the conductive black matrix. However, over time, as the device is folded and unfolded repeatedly, layer sliding occurs between the different layers, as seen in Fig. 1(c). Due to such sliding, the silver dotting can crack or disconnect, and the conductive matrix does not connect properly, leading to electrostatic charge accumulation as shown in Fig. 2, leading to the various display problems illustrated in Fig. 3.

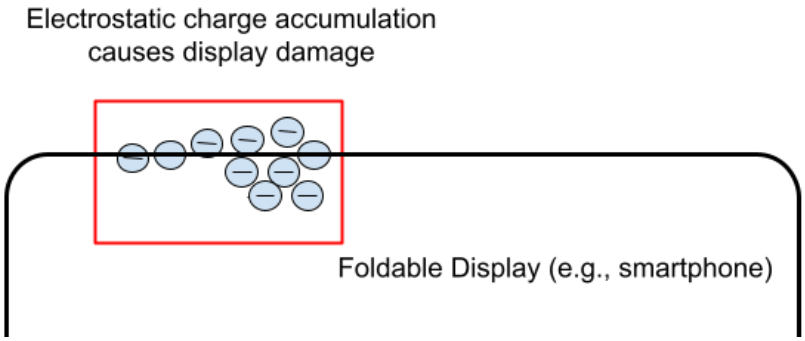

Fig. 2: Cross-sectional view of an electronic device with electrostatic charge accumulation

Fig. 2 illustrates a cross-sectional view of an electronic device (e.g., a foldable smartphone, tablet, or other device) with electrostatic charge accumulation. Electrostatic charge accumulation, as seen towards the top left of the figure can cause damage to the foldable display.

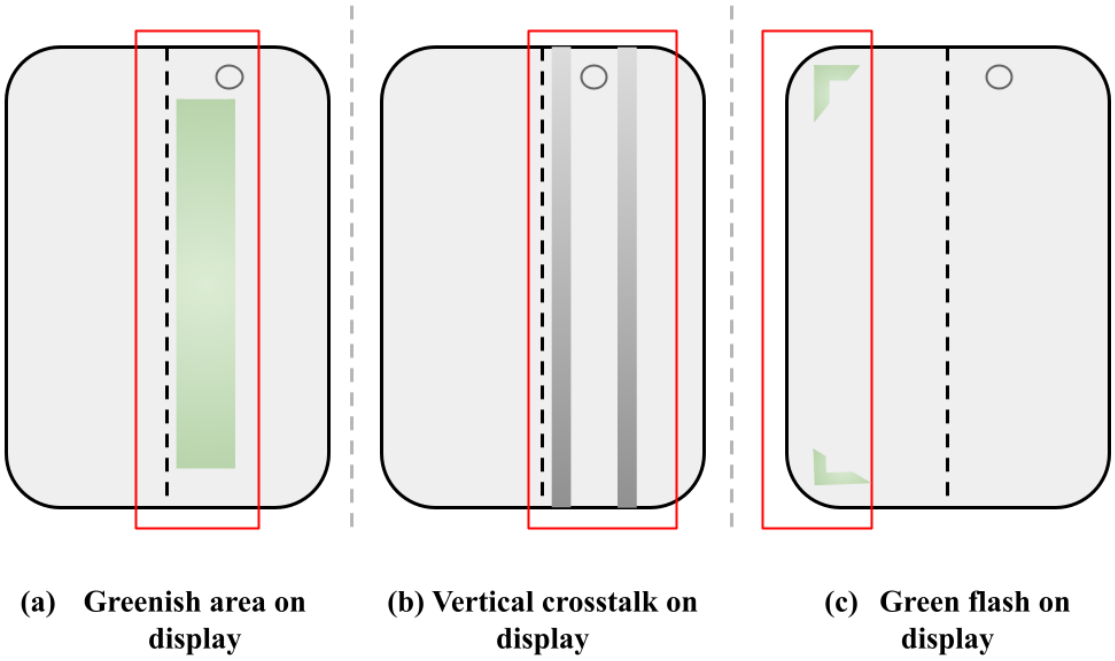

Fig. 3: Electrostatic charge accumulation in foldable displays leading to display abnormalities such as green flashes, vertical crosstalk, or a greenish display

Fig. 3 illustrates electrostatic charge accumulation in foldable displays leading to display abnormalities. Fig. 3(a) illustrates that accumulation of electrostatic charge in a particular region can lead to a greenish display in that region. Fig. 3(b) illustrates vertical crosstalk on the display caused by accumulation of electrostatic charge. Fig. 3(c) illustrates an example of a green flash on display.

However, for foldable displays, implementing silver dotting is challenging due to the movement and sliding of different layers, such as a plastic layer (PL) or an ultra-thin glass (UTG) layer. Additionally, the connection between the BM layer and the PL layer to the UTG layer tends to be poor in foldable displays.

DESCRIPTION

This disclosure describes a foldable display that implements an electrostatic discharge path as a grounding mechanism to avoid electrostatic charge accumulation at the edge of the

display. The described techniques eliminate or substantially display abnormalities that occur due to electrostatic charge accumulation.

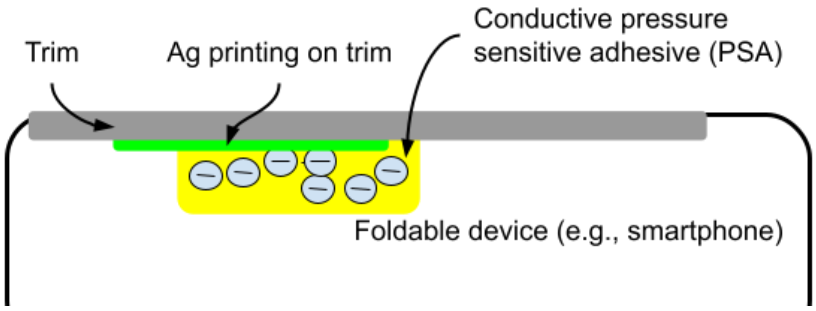

Fig. 4 : Cross-sectional view of an electronic device with silver printing on trim

Fig. 4 illustrates a cross-sectional view of an electronic device, per techniques of this disclosure. The grounding design includes silver printing (green) on the trim area of the device. The printed silver is linked to a conductive pressure sensitive adhesive (PSA) to release the electrostatic charge via the device enclosure.

If electrostatic charge builds up around the edges of the foldable display, the silver printing on the trim area provides a low-resistance pathway. The conductive nature of the silver layer enables efficient conduction of the charge towards the connected conductive PSA. The conductive adhesive enables the charge to be dispersed and grounded through the device enclosure. The discharge path is thus the silver printed layer, the conductive PSA, and finally, the device enclosure. In this manner, potential electrostatic discharge-related problems such as green flashes, vertical crosstalk, and a greenish display are eliminated.

CONCLUSION

For foldable displays, silver dotting that provides a grounding path for electrostatic charge can crack due to the movement and sliding of different layers as the device is folded and unfolded, causing disconnection from ground. This disclosure describes a foldable display that

implements an electrostatic discharge path as a grounding mechanism to avoid electrostatic charge accumulation at the edge of the display. The grounding design includes silver printing on the trim area of the device that is linked to a conductive pressure sensitive adhesive (PSA) to release the electrostatic charge via the device enclosure.

REFERENCES

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