Overview of elemental technologies for large sheet-type TV systems

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While 8K programming with ultrahigh-definition video can be viewed using different screen sizes, a large 100-inch display will provide viewers with a fully immersive experience, making them feel like they are actually at the broadcasting site. The advent of a lightweight, rollable, large display will pave the way to introducing large 8K systems to homes. The Science & Technology Research Laboratories (STRL) has been working on the following elemental technologies with the goal of constructing large, flexible-sheet organic light-emitting diode (OLED)* displays.

High-performance TFT using oxide materials
The size and resolution of displays will require placement of high-speed thin film transistors (TFTs) within the pixels. STRL is researching high-performance TFT technology for large-screen, high-definition displays.

Air-stable OLED devices with an inverted structure
Thinner, lighter, and more durable sheet-type displays can be realized by using flexible plastic substrate instead of rigid glass substrate. However, oxygen and moisture can permeate plastic and degrade the OLED. For this reason, research has focused on developing OLED devices that are resistant to oxygen and moisture.

Sheet-type panel fabrication technology
Because plastic has a lower resistance to heat and is prone to stretching/shrinking in comparison with glass, it requires a fabrication process that differs from conventional methods. STRL has been studying the panel fabrication technology to form a device such as a TFT or an OLED on a plastic substrate.

Time aperture adaptive control technology to balance picture quality and device life
An OLED display offers a solution to the problem of moving-picture quality degradation by increasing the instantaneous luminosity while shortening the emitting time ratio within a frame. However, the lifetime of the OLED device becomes short for the driving scheme. To resolve this tradeoff, we are developing new driving technology that can strike a balance between moving-picture quality and device lifetime.

Starting with the next issue, this series of articles will describe the elemental technologies that go into large sheet-type TV systems.

* organic light-emitting diode (OLED) : Emitting device using a phenomenon in which passing electric current through matter causes light to be emitted.
The realization a large sheet-type display to present ultrahigh-definition video such as 8K Super Hi-Vision (8K) will require a higher speed thin-film transistor (TFT) to control organic light-emitting diode (OLED) devices. The Science & Technology Research Laboratories (STRL) has been researching high-performance TFT technology based on oxide materials for 8K sheet-type displays. Oxide TFTs are promising candidates for driving devices in large-screen OLED displays because they can provide the high mobility (a measure of how easily an electron moves in a particular material) necessary to drive OLED devices and are adaptable to large-area fabrication. The oxide semiconductor IGZO (In-Ga-Zn-O)*1 has been under research and development at numerous institutions, and work has already begun on practical OLED displays based on IGZO-TFTs. On the other hand, making an 8K sheet-type display a reality will necessitate further improvements in mobility, low-temperature technology for forming devices on heat-sensitive plastic substrates, and flexibility so that driving remains stable even when the device is bent.

STRL has been developing high-mobility oxide semiconductors and corresponding device structures, along with low-temperature forming technology for plastic substrates and devices using highly flexible materials. We fabricated a TFT with approximately three times the mobility of IGZO through application of ITZO (In-Sn(Tin)-Zn-O)*2 with an optimized constituting element ratio and a flexible organic passivation layer. A prototype backplane*3 was also fabricated for a flexible OLED display. We have found that ITZO is at least as reliable as IGZO in long-period driving applications, and thus, it seems to be a promising material for practical 8K sheet-type displays.

Our work will continue on high-performance TFT manufacturing technology with the goal of making sheet-type displays.

*1 IGZO: indium-gallium-zinc oxide
*2 ITZO: indium-tin-zinc oxide
*3 Backplane: a TFT circuit substrate used to control the light emission in pixels