

The Inventors of TFT Active-Matrix LCD Receive the 2011 IEEE Nishizawa Medal

FROM DAY ONE of the invention of liquid-crystal display (LCD) at the RCA Research Laboratories back in 1964, the objective of the development had been to construct a flat television that could be hung on the wall. RCA presented a Press Conference about the invention at Rockefeller Center in New York City in 1968; immediately after, the scientists and engineers concerned with electronics displays in the world joined in the work of LCD to achieve the same goal [1].

The first epoch making event was the invention of the twisted-nematic (TN) mode of operation in 1970, which stabilized the operation and contributed to a high contrast ratio, thus making manufacturing LCDs very practical. The TN mode kicked off the industry of pocket calculators and digital watches. The inventors of the TN mode were awarded with the IEEE Jun-ichi Nishizawa Award in 2008 [2]. However, in trying to use the TN mode in a dot-matrix scheme that was required for television applications, engineers faced with a deadlock of not being able to achieve more than 60 scanning lines. Then, came a Super-Twisted Nematic mode, which succeeded to increase the number of scanning lines but gave another problem of not being able to display gray-scale and color pictures.

The solution to solve all the above problems came from the development of an Active-Matrix (AM) driving. The idea of driving LCD with using thin-film transistors (TFTs) at cross sections of the matrix was first conceived by Bernard Lechner of RCA Laboratories [3]. The concept was presented as early as 1968 at the RCA's Press Conference. He and his colleagues even demonstrated a 2-by-18 matrix display with using a Dynamic Scattering mode, the only mode of operation known at that time.

Then in 1974, the first flat display, 6-inch by 6-inch, was demonstrated by Peter Brody, Fang Lou, and their colleagues of Westinghouse by using the AM driving and cadmium selenide as a base material for the TFT [4]. Brody coined the term "active matrix" and introduced it in the literature in 1975. The demonstration made LCD researchers and engineers jump into the work of TFT Active-Matrix drives. In 1988, with the use of hydrogen-added amorphous silicon for the TFT, a display of 14-inch diagonal, full color and real motion, was demonstrated by the engineers of Sharp Corporation. This convinced the electronic industry that LCD would soon replace cathode-ray tube (CRT), which had been a standard display component of television receivers, and would make it possible to achieve the flat television.

The TFT AM LCD was first supplied as a display to the PC industry in 1990s. In 2003, it started being used for television receivers. The industry of LCD had surpassed the industry of CRT in dollar wise in the year of 2000, and is ever growing becoming over \$120 Billion Dollars in 2011 (supplied by IHS iSuppli).



Fig. 1. Recipients of the IEEE Jun-ichi Nishizawa Medal.



Fig. 2. Recipients of the IEEE Jun-ichi Nishizawa Medal. From Left to right: Bernard J. Lechner, Fang-Chen Luo (not present: Peter Brody)

The base concepts and technologies underlying the current LCD industry are the TN mode and its derivatives, and the TFT Active-Matrix drive.

At the Honors Ceremony held in San Francisco at the Marriott Hotel on August 20, 2011, the three inventors of the TFT Active-Matrix LCD received the IEEE Nishizawa Medal, as shown in Fig. 1 where both Bernard Lechner and Fang Luo were present (Fig. 2). The number of electronic equipment that uses the TFT AM-drive LCDs outstanding in the consumer's and businessman's hands in the world is considered to be over 9.4 Billion units (computed by accumulating the shipments of the TFT AM LCDs for use in cellular phones, smart phones, TVs, monitors, and PCs for the period of 2009 to 2011, IHS iSuppli).

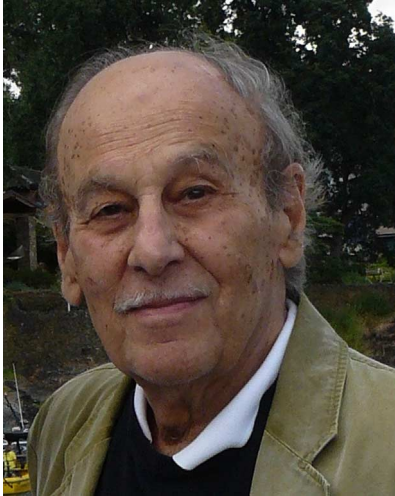


Fig. 3. Thomas Peter Brody

This number is greater than the world population of 7 Billion. The invention of the TFT Active-Matrix Drive is not only one of the greatest technical achievements in the 20th Century, it

greatly enriched our life and enhanced business activities, not to mention cell phones, smart phones such as iPhone, compact mobile phones such as iPad, flat TVs, and PCs.

Unfortunately, Peter Brody could not make the Honors Ceremony. Later, we learned that he had passed away on September 18, 2011, in Pittsburgh, PA, less than a month after the reception. We should memorialize him and appreciate his spearheading work in the field of liquid-crystal displays (Fig. 3).

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