

Brief History of LCD

In 1888, Friedrich Reinitzer (1858-1927) discovered the liquid crystalline nature of cholesterol extracted from carrots (that is, two melting points and generation of colors) and published his findings at a meeting of the Vienna Chemical Society on May 3, 1888 (F. Reinitzer: Beiträge zur Kenntniss des Cholesterins, Monatshefte für Chemie (Wien) 9, 421-441 (1888)).[1]

1904: Otto Lehmann published his work "Liquid Crystals".

1911: Charles Mauguin described the structure and properties of liquid crystals.

1936: The Marconi Wireless Telegraph company patented the first practical application of the technology, "The Liquid Crystal Light Valve".

1962: The first major English language publication on the subject "Molecular Structure and Properties of Liquid Crystals", by Dr. George W. Gray.[2]

1962: Richard Williams of RCA found that liquid crystals had some interesting electro-optic characteristics and he realized an electro-optical effect by generating stripe-patterns in a thin layer of liquid crystal material by the application of a voltage. This effect is based on an electro-hydrodynamic instability forming what is now called "Williams domains inside the liquid crystal".[3]

1964: In the fall of 1964 George H. Heilmeyer, then worked in the RCA laboratories on the effect discovered by Williams realized the switching of colors by field-induced realignment of dichroic dyes in a homeotropically oriented liquid crystal. Practical problems with this new electro-optical effect made Heilmeyer to continue work on scattering effects in liquid crystals and finally the realization of the first operational liquid crystal display based on what he called the dynamic scattering mode (DSM). Application of a voltage to a DSM display switches the initially clear transparent liquid crystal layer into a milky turbid state. DSM displays could be operated in transmissive and in reflective mode but they required a considerable current to flow for their operation.

Pioneering work on liquid crystals was undertaken in the late 1960s by the UK's Royal Radar Establishment at Malvern. The team at RRE supported ongoing work by George Gray and his team at the University of Hull who ultimately discovered the cyanobiphenyl liquid crystals (which had correct stability and temperature properties for application in LCDs).

1968: NCR's John L. Janning invented liquid crystal displays (LCD). NCR History. Retrieved on 2008-01-24.

1970: On December 4, 1970, the twisted nematic field effect in liquid crystals was filed for patent by Hoffmann-LaRoche in Switzerland, (Swiss patent No. 532 261) with Wolfgang Helfrich and Martin Schadt (then working for the Central Research Laboratories) listed as inventors.[4]

Hoffmann-La Roche then licensed the invention to the Swiss manufacturer Brown, Boveri & Cie who produced displays for wrist watches during the 1970's and also to Japanese electronics industry which soon produced the first digital quartz wrist watches with TN-LCDs and numerous other products. James Ferguson at the Westinghouse Research Laboratories in Pittsburgh while working with Sardari Arora and Alfred Saupe at Kent State University Liquid Crystal Institute filed an identical patent in the USA on April 22, 1971.[7] In 1971 the company of Ferguson ILIXCO (now LXD Incorporated) produced the first LCDs based on the TN-effect, which soon superseded the poor-quality DSM types due to improvements of lower operating voltages and lower power consumption.

1972: The first active-matrix liquid crystal display panel was produced in the United States by T. Peter Brody.[8]

2008: LCD TVs are the main stream with 50% market share of the 200 million TVs forecasted to ship globally in 2008. [9]

A detailed description of the origins and the complex history of liquid crystal displays from the perspective of an insider during the early days has been published by Joseph A. Castellano in "Liquid Gold, The Story of Liquid Crystal Displays and the Creation of an Industry" [10].

The same history seen from a different perspective has been described and published by Hiroshi Kawamoto, available at the IEEE History Center.