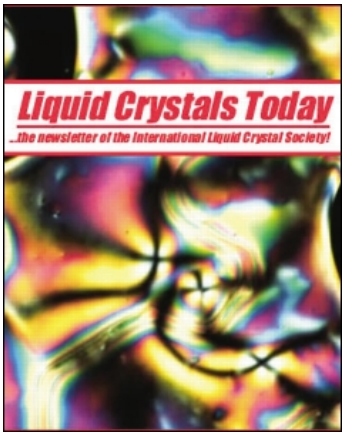

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Ferroelectrics & Antiferro-electrics enter the Display market

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FLCDs: the route to Market

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Ferroelectric LCDs represent one of the latest liquid crystal technologies, the main attributes of which are very fast switching, typically <100μs and bistability. This combination of properties enables ferroelectric LCDs potentially to provide complex, alphagraphic displays for a variety of applications.

It was R Meyer in 1975 who predicted that chiral tilted smectic liquid crystals would exhibit ferroelectricity and hence possess a large spontaneous polarisation oriented perpendicular to the director. The chirality required to induce ferroelectricity also promotes a helical structure, which (as noted by Meyer) has to be removed in order to provide a useful device. This was first done by shearing the glass substrates that enclosed the ferroelectric liquid crystal and is now achieved by the use of rubbed polyimide surface alignment layers, similar to those used in nematic-based LCDs. In both cases, the spacing between the two substrates is ideally less than 2μm.

The structure and fabrication of ferroelectric LCDs is very similar to that of a supertwist LCD. The two main differences are the use of a 2μm, compared with 5-6 μm for supertwist LCDs, cell spacing and the requirement to heat both the ferroelectric liquid crystal and the display cells to 80-100°C during the vacuum filling process. The impact of these two differences is that the volume manufacturing costs of ferroelectric LCD glass are likely to be ~10% higher than those for supertwist LCDs. The cost of the drive electronics for ferroelectric LCDs is likely to be similar to that for supertwist displays. Although the cost of the drivers for complex alphagraphic ferroelectric LCDs with frame times of ≤50ms will probably be higher, because of the need for a voltage swing of 100V compared with 35V, the higher multiplexing

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Ferroelectrics & Antiferroelectrics enter the Display market

from S T Lagerwall, Chalmers University of Technology, Physics Dept, Liquid Crystal Gp, S-412 96 Göteborg, Sweden

During the recent FLC' 93 Conference in Tokyo some impressive demonstrations were given of the present state and the future potential of the FLCs in various types of display.

Canon decided in 1985 to make major investments in the FLC technology after a couple of years of corporate research. At the FLC'89 in Göteborg, Sweden, they showed the first A4 size monochrome FLC display for PC application. In 1993 Canon presented a second generation of displays at shows held in New York and Paris. Some of these could also be seen at the FLC'93 exhibition. The first product on the market is a desk-top publishing system containing keyboard, screen, computer and laser printer. The screen is a monochrome ferroelectric vertical A4 size (15 inch) with 1280 x 1024 picture elements each capable of 4 grey levels. The complete system sells for $15,000. The corresponding colour screen is made for horizontal format and, with the same number of pixels, can produce 16 colours in every pixel. There is also a super high resolution monochrome version of the latter one with 2560 x 2048 picture elements. The contrast is better than 40:1 in all cases. The two most interesting screens (not displayed at FLC'93 but in the New York and Paris Shows) are perhaps the 24 inch (A3 size) black and white and the 21 inch 64 colour version. Both of these are made with a new alignment technique and using a layer thickness of only 1.1 μm. The colour screen can be driven at video speed if using half the vertical resolution, i.e. by scanning the screen as if it had 512 lines. The successive development of a shock-proof tech-

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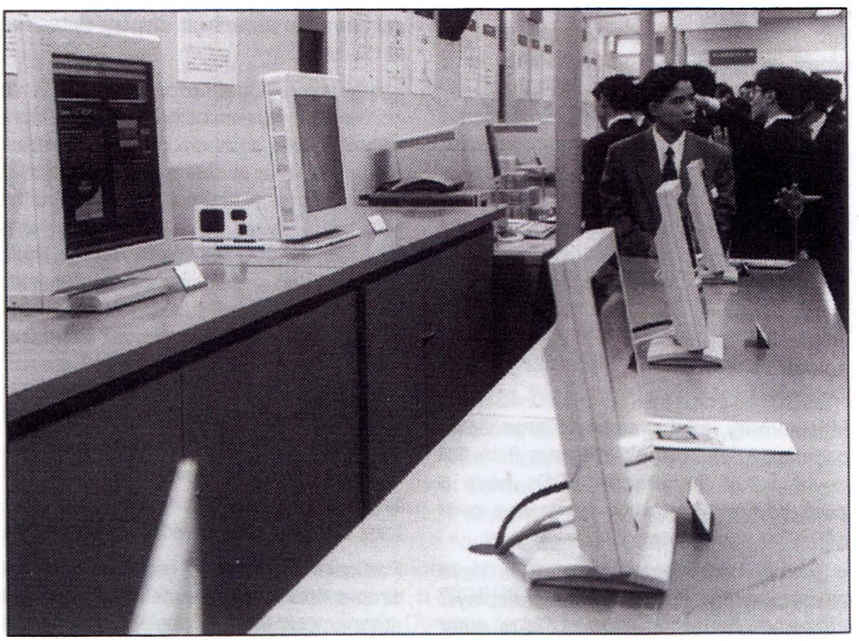

A variety of Canon FLC displays at a recent trade exhibition

Ferroelectrics & Antiferroelectrics enter the Display market *(cont. from page 1)*

24 inch black and white FLCD display, 16 levels of grey

nology at Canon during the last years has resulted in panels withstanding mechanical shocks of 60 G. The new Canon FLC factory will start production in July 1994 after two years of construction and 4 months of running-in time. The production line is laid out for 24 inch size panels which corresponds to the most common size for TV sets used in homes today.

The very interesting recent news is that Canon has decided not only to sell complete desk-top publishing and PC systems but also to offer the screens (all IBM PC compatible) to be inserted in other systems. The first versions on sale will be the vertical monochrome 15 inch and two new colour 15 inch screens with 32,000 colours and 260,000 colours, respectively. The colours are generated with the same technique as used in Canon's colour printing technology.

Also at FLC' 93 Nippondenso showed the first prototype of an antiferroelectric display in full colour. Antiferroelectrics are a subclass of ferroelectrics with certain properties of great interest for liquid crystal displays. Besides the very simple method of producing analog grey levels by amplitude modulation the Nippondenso panel demonstrated the two most important features of FLC and AFLC which are maintained in the so-called quasi-bookshelf texture: first there is a viewing angle that is almost hemispherical, second the displays have an outstanding transmission and brightness (more than twice that of TFT-LCD.) The AFLC displays will be serious competitors to small and medium size TFT-LCDs, even if the contrast ratio compares less favourably (20:1 against 150:1 for some TFT displays). The Nippondenso prototype panel is 6 inches in size with 320 x 220 picture elements. Straightforward scanning of 220 lines allows video speed operation. The panel is being developed mainly for car navigation systems as first target. After a second prototype in about a year, the decision will be taken for volume production. Thus the AFLC panels may be on the market in about two years.

Finally the FLCP (ferroelectric liquid crystal polymer) displays shown by Idemitsu are produced as plastic sheets, 15 and 30 cm wide and in principle to any length. They are quite flexible and contain neither spacers nor alignment layers. In addition to a direct driven 30 cm wide panel with very large characters, a smaller multiplexed display was shown having 288 x 96 picture elements and an active area of 36 cm x 12 cm. Previously, few smectic displays have been shown and the market has been quite limited. With FLCDs and AFLCDs, the time for smectics may finally have arrived. ❐