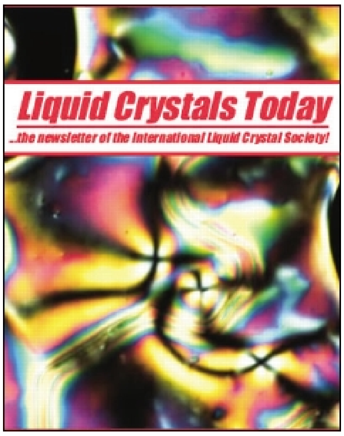


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# Recent news from liquid crystals in industry

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# NEWS

## Recent news from liquid crystals in industry

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### Indium: no longer a 'poor metal'

In the summer of 2008 when oil prices surged to US$150 a barrel, up from US$60 the year before, this caused plenty of anger from motorists at the pumps being forced to pay an amount that was way above inflation. Compare this to a material that increased in price by a factor of ten between 2003 to its high of over US$1000/kg in 2006, but yet is widely used and most households possess a number of devices containing it. The material in question is of course indium, which at first seems to be a rather ordinary soft metal closely resembling zinc, located in the post-transition metals or 'poor metals' section of the periodic table. Upon further inspection however, indium also has very useful properties that means its demand regularly outstrips supply, notably its ability to wet glass. In the form of indium tin oxide (ITO) is where the value of indium is truly revealed, accounting for over 70% of the total global consumption. This demand has surged over the past 5 years due to the use of ITO as a transparent conductive coating, primarily in displays. To a lesser extent this has also affected many companies and university research groups that have noticed the price of indium containing solder rocket over the years.

The world's largest producer of indium is China, controlling over 60% of the world's refined indium production. Interestingly, indium is only a byproduct from the mining of other metals, mainly zinc, but it is also present in iron, lead and copper ores, although it is not usually commercially viable to extract indium from these. In recent years, due to the extraordinary rise in the cost of buying indium, many companies now recycle and recover Indium from various sources. For example, the use of ITO in manufacturing is only around 20% efficient, requiring the remaining 80% to go through a recovery process that takes several weeks at considerable cost. Added to this, it is predicted that indium demand will increase further due to its use in solar cells, a rapidly growing market worldwide. It is therefore concerning that some sources suggest there could be less than 10 years supply of indium left globally, given that it is a relatively rare metal combined with the alarming rate we are using it at. All of these factors suggest that an alternative to indium would not only be useful, but possibly even necessary...

### ...Carbon nanotubes as a conductive coating

Trying to avoid the mention of carbon nanotubes in the scientific community is akin to trying to avoid rain during a British summer. The latest high profile research involving carbon nanotubes includes applications for use in chemical and biological sensors, as well as potential uses in optoelectronics. Films made from carbon nanotubes can be produced to be as thin as 10 nm, making them transparent to visible light whilst still being electrically conductive. This makes them suitable as a potential alternative, or indeed successor, to the current method of coating surfaces with ITO for applications such as displays, solar cells and organic light emitting devices (LEDs).

A major advantage that carbon nanotube films possess over ITO is their flexibility and their high durability. It has been demonstrated that such films can be bent repeatedly and even hit with a hammer, and still remain intact. This property alone makes carbon nanotubes appealing to the large electronics companies, and it is thought that by the end of the year the first touch screens containing such an electrode will be available. One such smaller company producing these early products is Unidym from California, but Samsung have already demonstrated a prototype 14.3-inch colour electronic paper device made using carbon nanotube films.

Carbon nanotube films are also much easier to deposit on glass and plastic substrates, as well as being more robust. The future is certainly bright for this fast growing technology, with research already in the advanced stages for their use in thin solar cells. It seems that if you were betting on the mention of carbon nanotubes to reduce in the near future, that you would instead be better off accepting the inevitable and buying an umbrella.

### Samsung blue phase display

It is well known that standard liquid crystal devices (LCDs) have their limitations, although this has not

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stopped them being the primary choice in households and businesses worldwide for both computing and televisions. A typical computer monitor will have millions of individual liquid crystal cells, or pixels, which can be individually switched between a bright state and a dark state through the use of an electric field. One of the problems with standard nematic displays is that this switching occurs via a physical 90° rotation of the liquid crystal molecules, and due to it being a viscous fluid; there are intrinsic constraints on the timescale this can occur at, regardless of the strength of the field. A typical computer monitor or television would operate in the region of 50 Hz, meaning that the perceived motion on the screen is actually built up from 50 individual still images placed one after another every 20 ms. For most applications this is not a problem, but for fast moving video, such as a Formula 1 race, this can result in 'motion blur' and makes a noticeable difference to viewing.

The large electronics companies, such as Sony, have worked hard at trying to compensate for this, and the high end LCD televisions that are currently available can produce a physical refresh rate of 100 Hz due to extensive research into new materials. It has been commented that displays using nematic liquid crystals will not be able to get much faster and other avenues have been investigated to improve on this. Many LCD televisions now use an overdrive circuit, which extrapolates an extra frame by looking at the previous and next frame and inserting the average of these. Due to this, companies such as Sony can now advertise their 200 Hz displays with 'Motionflow' technology, but with the ever-increasing demand from consumers, Samsung realised that they could not stop there.

First unveiled in 2008 at the Society for Information Display international symposium in Los Angeles, Samsung has shown a working model of a 15-inch blue phase LCD. The blue phase requires no alignment layers, giving the potential for cheaper manufacturing costs, but more importantly due to its unique switching properties, the response time is of the order of 10 μs. The Kerr effect is utilised to directly induce birefringence in the blue phase material via the application of an electric field, which results in a change in transmission. The model shown last year had a refresh rate of 240 Hz without any additional electronics and has the potential to go much faster still. Samsung aims to mass produce these displays in 2011, and although they will likely be expensive at first, it would be of little surprise if they became the display of choice in ten or even five years time. Bearing in mind that 'classic' cathode ray televisions are not even sold on the high street anymore, few can doubt how quickly the display industry can change. Refresh speed is increasingly important with the publicity surrounding high-definition and blu-ray technology and it may not be long until the blue phase is the new technology that everyone is talking about.

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