Abstracts

Polarized Electroluminescent Devices based on Nematic Liquid Crystalline Semiconductors.

M. O'Neill and S. M. Kelly

This paper reviews light-emitting nematic, liquid crystal semiconductors and their use in linearly polarised Organic Light-Emitting Diodes (OLEDs). The materials and processes used to provide hole transport and alignment to the liquid crystal light-emitting film are discussed. Both mechanical rubbing and photoalignment give good alignment and photoalignment allows the spatial patterning of the polarisation direction of the light-emission. We review light-emitting liquid-crystalline polymers, oligomers and reactive mesogens in polarised OLEDs and discuss the factors which influence device performance. To date polarisation ratios up to 31 in electroluminescence and device efficacies up to 6.5 cd A^{-1} have been obtained. We believe that the device efficiencies can be further improved by modification of the alignment/transport layers. Possible applications for polarised OLEDs are also discussed.

Organic Synthesis that is Potentially Applicable to the Preparation of Liquid Crystalline Materials

Atsunori MORI

Transition metal-catalyzed synthetic reactions are described that are potentially applicable to the synthesis of liquid crystalline materials. The Sonogashira coupling, which is a cross-coupling reaction of terminal alkynes with organic halides, takes place with aqueous ammonia. Palladium-catalyzed cross coupling of organosilicon compounds with aryl halides can be applied for biaryl synthesis. A specific C-H bond of heteroaromatic compounds is substituted with various aromatic groups by the catalysis of a transition metal. Finally, several 2,5-diarylated thiophenes and thiazoles are synthesized in a combinatorial manner.

Keywords : Liquid crystalline materials, Transition metal catalyst, Cross-coupling reaction, Sonogashira coupling, C-H substitution reaction, Organosilicon compounds, Tolane, Biaryl, Thiazole, Thiophene

Phase Matching of Optical Third-harmonic Generation Using a Large Birefringence of Liquid Crystals

Kotaro KAJIKAWA

We performed the type-II phase matching condition of direct third-harmonic generation ($3\omega = \omega + \omega + \omega$) in nematic liquid crystals using fundamental light of 1064 nm. This condition makes use of the properties of nematic liquid crystals : a large birefringence and relatively small frequency dispersion in their refractive indices. Since the phase-matching condition can be achieved at normal incidence of the fundamental beam, the walk-off angle is absent. Thus, the interaction length is equal to the thickness of the liquid crystal film. Although the conversion efficiency of $\sim 9.1 \times 10^{-8}$ is not sufficiently high for materials for the frequency conversion devices, we give some proposals that improve the conversion efficiency to be in the order of 10^{-2}.

Keywords : Third-harmonic generation, Nonlinear optics, Phase matching

Microwave and Millimeter-Wave Control Devices Using Liquid Crystals

Takao KUKI, Hirokazu KAMODA, Hideo FUJIKAKE and Toshihiro NOMOTO

Liquid crystals (LCs) have a large birefringence in permittivity within the microwave and millimeter-wave frequency range. The alignment of liquid crystalline molecules can also be changed by using a bias electric field, so that the permittivity of the LC can be varied electrically. Various microwave and millimeter-wave control devices employing this feature of LCs have been reviewed.

Firstly, dielectric properties of many kinds of LC materials have been evaluated in detail. Next, micros-

trip-line-type microwave variable delay lines using LCs have been fabricated. Experimental results have shown that the devices have non-dispersive delay characteristics over the entire microwave frequency range. Lowering insertion loss and speeding-up the phase-shift response time on the LC variable delay line have also been investigated. Lastly, a millimeter-wave beam former using LCs, which can electrically steer and shape millimeter-wave beams, has successfully been demonstrated.

Keywords : Liquid crystal, Microwave, Millimeter-wave, Permittivity, Variable delay line, Phase shifter, Antenna beam steering, Lens