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Advanced Display Technologies 2006

October 03-05, 2006

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Academician O. Krokhin, General Chair
Prof. I. Kompanets, Program Chair, both P.N. Lebedev Physical Institute

Event is organized by:

1. Russia Chapter of the Society for Information Display
2. Byelorussia Chapter of the Society for Information Display
3. Ukraine Chapter of the Society for Information Display
4. P.N.Lebedev Physical Institute of Russian Academy of Sciences

Event is sponsored by:

1. The International Society for Information Display (SID)
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Information Support by:

1. Information Display
2. Display Solutions
3. Electronic Components

SYMPOSIUM TOPICS

- LC and other non-emissive displays
- Emissive displays (PDP, CRT, FED, LED, OLED, electroluminescent…)
- Microdisplays
- Projection displays
- Flexible displays
- 3D displays
- Display Optics
- Display Electronics
- Display Ergonomics, standards, measuring and testing
- Displays and Systems for civil and military applications

Scientific program

General view of Big Conference Hall of FIAN. From left to right: R. EIDENSCHINK, Nematel, Germany (winner of 2006'Freederickx Medal of Liquid Crystal Society COMMONWEALTH), L. KUTULYA, Institute of Single Crystals of NASU, Kharkov, Ukraine, S. TORGOVA, FIAN, Moscow, P. SURMAN, Montfort University, UK, V. LOIKO, Institute of Physics of NASB, Minsk, Byelorussia.

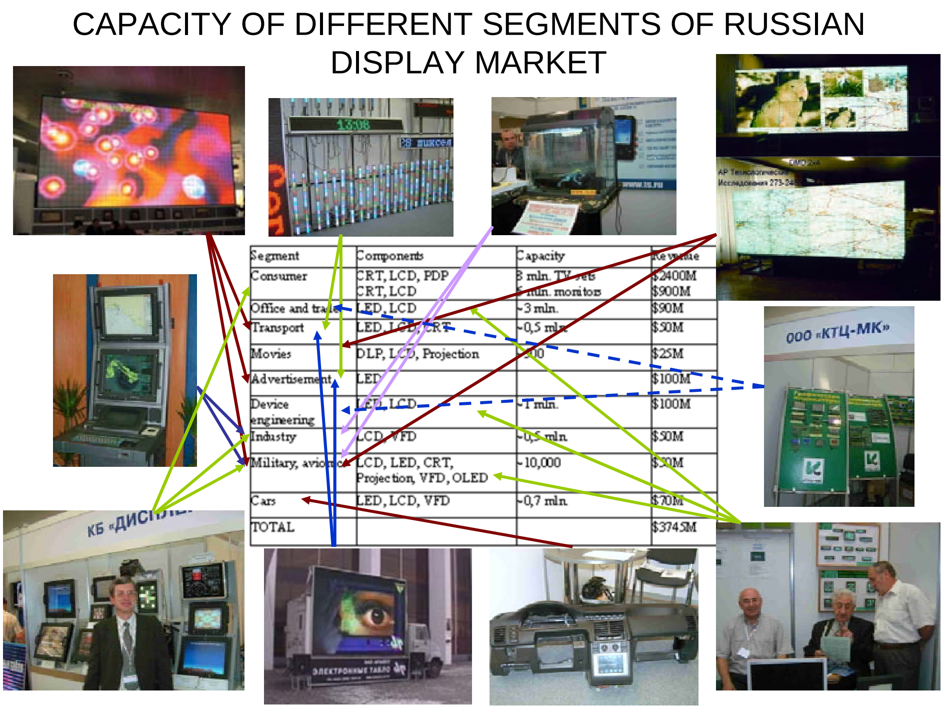
Academician O. Krokhin, General Chair of ADT-06, Vice-Director FIAN, opening ADT-06

Leaders of three East-European Chapters of The SID: A. Smirnov, Byelorussia, Vice-President of The SID; V. Sorokin, Director of SID Ukraine Chapter, I. Kompanets, Chair of SID Russia Chapter

Selected presentations/reports

October 3, 2006
Plenary Session

1. V. Belyaev *(Samsung Research Center, Moscow, Russia).*
Display Technologies and Market in Russia (opening lecture)**.**



Segment	Components	Capacity	Revenue
Consumer	CRT, LCD, PDP CRT, LCD	3 mln. TV sets 5 mln. monitors	$2400M $900M
Office and trade	LED, LCD	~3 mln.	$90M
Transport	LED, LCD, CRT	~0,5 mln.	$50M
Movies	DLP, LCD, Projection	[illegible]	$25M
Advertisement	LED		$100M
Device engineering	LED, LCD	~1 mln.	$100M
Industry	LCD, VFD	~0,5 mln.	$50M
Military, avionics	LCD, LED, CRT, Projection, VFD, OLED	~10,000	[illegible]
Cars	LED, LCD, VFD	~0,7 mln.	$70M
TOTAL			$3745M

Capacity of different segments of Russian display market and examples of Russian and Byelorussian display products

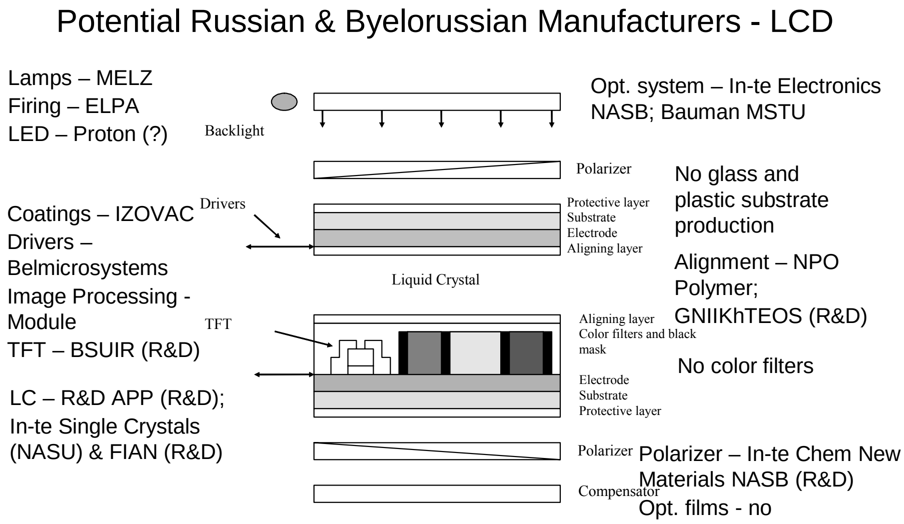


Illustration of opportunity of production of display components in Russia and Byelorussia

2. Academician V.Labunov *(Byelorussian State University of Informatics and Radioelectronics, Minsk), presented by A. Smirnov.*

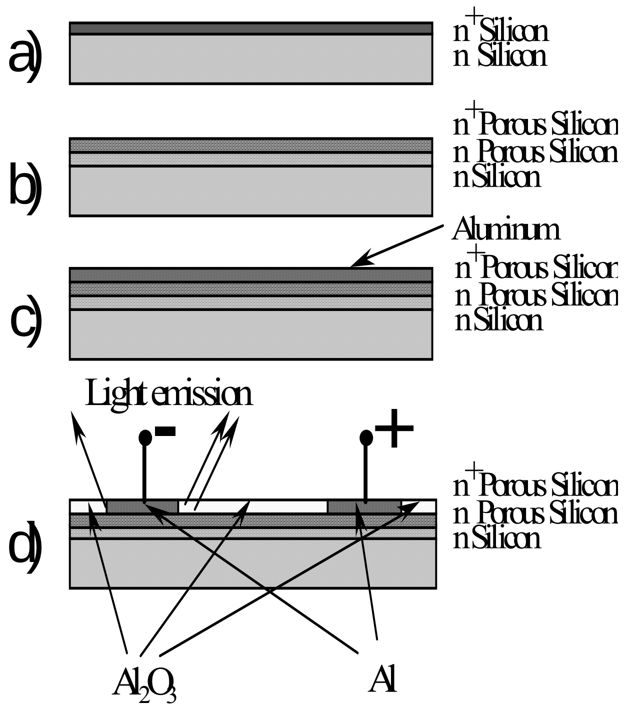
Present state and prospects of nanomaterials and nanotechnologies for new generation of information and communication systems.

The main goals and content of two national programs "NANOTECH" and "ELECTRONIKA" for years 2006-2010 were discussed. All projects of these programs are dealing with investigation of the components (transistors; displays; solar cells; gazo-, chemo-, bio-, sensors; micro-fuel cells; electronic-optical and electro-mechanical elements) for new generation of the information and communication systems by the scaling to the nanosizes the components of the Si technology as a basic one and expending the functional possibilities of these components by the utilization of the specially elaborated nanostructured inorganic and functional organic materials such as porous Si and Al_2O_3, nanoparticles, nanotubes, nanowires, self assembling nanolayers and bio-structures.

3. A.Smirnov, S.Lazarouk, V.Labunov, P. Poznyak, A.Berezovik (*Byelorussian State University of Informatics and Radioelectronics,Minsk*).

Silicon-based microdisplays: the experience of design and manufacturing.

Main steps of designing and manufacturing of microdisplays for NTE applications have been described. Two types of devices will be discussed e.g. reflective LCOS- microdisplays and light emitting LED-microdisplays based on nanoporous silicon. LED samples based on porous silicon (PI) have spectral maximums 680 nm, 640 nm and 580 nm respectively, life time > 10000 h, luminous efficiency ~1.2%, optical power density 0.1 W/cm^2, response time 1.2 ns at Minimal pixel size 1x1 μm that make them attractive components for high resolution displays with high frame rate frequency.



Schematic view of fabrication process and a PS LED structure: a) n-type silicon wafer with n^+-diffused layer; b) after anodization in transition regime, PS is formed both in n^+- film and in a substrate layer; c) aluminum layer is deposited by magnetron sputtering; d) the final structure after photolithography and sub-sequent aluminum anodization. Light emission at the edge of negative biased pad is evidenced.

4. N.P. Abanshin, N.D. Zhukov, I.A. Zimin, A.V. Kuznetchikhin, R.V. Mhitarjan (*R&DI "Volga", Saratov, Russia*).

OLED: improvement of technology process and increasing the service life.

The basic results of researches are resulted in the choice of modes to preliminary preparation of a surface of electrode metal layers, in particular ITO, before deposition of organic layers of OLED- structure. The influence of deposition methods for organic layers and their thickness on electro-optical characteristics OLED was analyzed. The measured values of brightness, current and voltage for various thickness transport layers and the designed values of point efficiency submitted. Various ways of hermetic encapsulation allowed brake degradation process of OLED organic layers.

5. Ph. Surman, I. Sexton, W.K. Lee, R. Bates *(De Montfort University, UK)*, K. Hopf (*Heinrich Hertz Institute, UK*), E. Buckley (*Light Blue Optics, UK*).

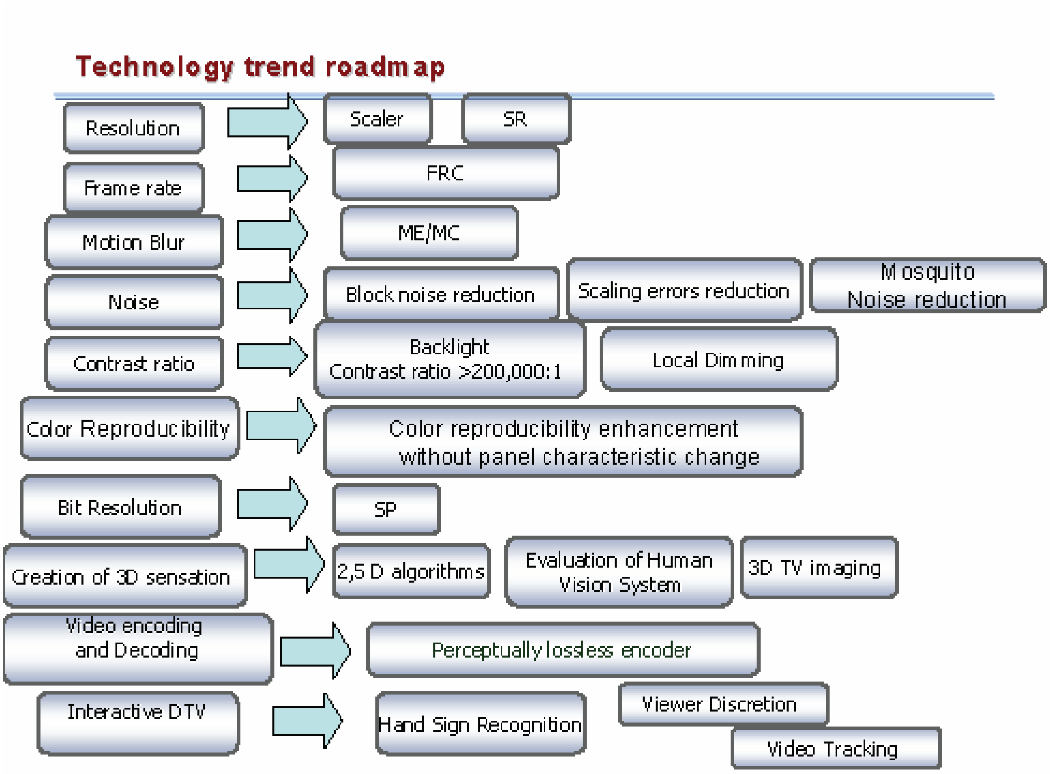
Multi-user 3D Display using a Head Tracker and RGB Laser Illumination Source.

A 3D display that incorporates an RGB laser as the backlight for an LCD and a head position tracker is described. The display provides 3D to several viewers, each of whom does not need to wear special glasses and is able to move freely over a large area. It operates on the principle of forming exit pupil regions where either a left image or a right image is seen on the screen. These follow the positions of the viewers eyes by using the output of the head tracker to control the backlight optics.

The stereo image pair is displayed on a direct-view LCD, and steering optics behind this form the pupils. Currently the two images are spatially multiplexed with left and right images presented on alternate pixel rows. An RGB laser source illuminates a series of binary phase holograms displayed on an LCOS panel, which acts to direct light to the appropriate positions on a series of optical arrays according to information supplied by the head tracker. The arrays enable exit pupils to be formed over a large viewing region by employing novel coaxial optical elements.
A high-precision 3D video head tracker has been developed that employs an appearance-based method for initial head detection and a modified adaptive block-matching technique for head and eye location measurements in the tracking phase. The adaptive block-matching approach compares the current image with eye patterns of various sizes, which are stored during initialization.

6. E.V. Vorobiev, V.V. Belyaev (*Samsung Research Center, Moscow, Russia*).

Modern trends of video processing for digital TV.



Special Session: Liquid Crystal Society Awards

Rudolf Eidenschink. LC materials for display and industrial (tribology) applications.

Rudolf Eidenschink and Victor Belyaev after awarding ceremony

Session: Systems and Application

1. V.V. Petrov, K.A. Grebenyuk (*Saratov State University, Russia*).

Enhancement of stereoscopic images quality: optical correction of depth plane curvature.

The presentation is aimed to development of the method for correction of stereoscopic image distortion termed depth plane curvature. Depth plane curvature is such a distortion that makes objects at the centre of the screen look closer to observer then objects at the corners of the screen, whereas in the real world they do not.
This distortion occurs when viewing stereoscopic images obtained with converged camera configuration and could lead to wrong perception of relative objects distances. In present study the authors proposed possible method for correction of depth plane curvature using especial optical configuration for the stereoscopic display. The main idea of the method is to display left and right perspective views at different planes (screens) intersecting at definite angle. Possible realization of proposed intersecting screens configuration with current display technologies was described.

2. A. Andreev, Yu. Bobylev, I. Kompanets, E. Pozhidaev, V. Shoshin, Yu. Shumkina, S.Torgova (*Lebedev Physical Institute of RAS, Moscow, Russia*), A. Alyushin, M. Alyushin, S. Gonchukov (*Moscow State Engineering Physics Institute, Russia*), A.Strigazzi (*Politecnico di Torino, Italy*).

Experimental model of 3D volumetric display based on 2D laser beam deflector and a stack of FLC light-scattering shutters.

A prototype of 3D display with a multilayer volumetric screen of 10 LC shutters was designed, and its work was demonstrated. The light scattering was switched on and off in shutters in turn along Z direction. Section images on scattering shutters were visualized due to the laser diode beam which was scanned in XY directions by the fast and compact TeO2 acousto-optical deflector (any point can be addressed for 2 s). Laser diodes of R and G colors were used. Possible parameters of real 3D volumetric display were estimated.

3. A.V. Sadchikhin, E.N. Rytov, V.I. Nekljudov, E.E. Akimov (*«AR Technology», Moscow, Russia*).

Multicomponent screens of collective usage for extremes condition of application.
An analysis of the most widespread technologies of joint of screens in videowalls was made. It was shown, that they have a series of essential lacks: the big optical gap (1.5 – 2.0 mm) at the declared mechanical gap of 0.5 mm, the limited range of operation temperatures from 5˚C up to 30˚C (optimum temperature from the point of view of operation of the screen 20˚C +/-3˚C) and humidity up to 80 % (without a condensate).
The new patented technology of fastening of screens was discussed. The technology (it is named «the image without borders») provides an optical gap between screens about 0.1 mm in a range of temperatures from 0˚C up to 50˚C (and more) and humidity from 0 % up to 99 %. Thus there is no curvature of screens. Results of development earthquake-proof the multicomponent screen for block control panels of nuclear stations which maintains seismic influences in size of 7 points under the Richter scale on a mark of 10 meters are shown.

4. Yu. Trofimov, V. Posedko, V. Sivenkov, S. Lishik (*Institute of Electronics NAS of Byelorussia, Minsk*).
LED information boards: the experience of design, manufacturing and application

5. V.B. Lukashenko, M.V. Dyatlov (*JSC "KB Technotronic", Fryazino, Russia*).

Multifunctional Display for Transport Application.

1) MFD-26 - (multifunctional display) - smart unit, vehicle computer able to receive sensors signals, process it and to display the analyzing results in the image form on the screen 10' size.
2) MFD-26 has very high EMI durability that allowed by using:
- CAN interface for data buses
- custom developed filtration for the power, ground buses and the case of the unit.
3) MFD-26 can be upgraded:
- custom sensors (temperature, light sensors and so on).
- CPU rate
- memory.
The unit processing capabilities are defined by standard PC-104 board that can be easily upgraded so as the customer needs.
4) The unit has excellent vibration durability that ensured by custom developed vibration and shock absorption system.
5) The unit is extremely durable in the harsh climatic environment that ensured by the using custom developed software and hardware that controls heating the LCD and backlight.
6) The units indication unit can display image with excellent optical performance ensuring readability in any illumination conditions from full darkness to direct sunlight. The optical performance is ensured by using custom developed antireflection glasses, optical films, backlight unit and LCD screen.

6. A. Martinovich, A. Maximov, O.Kursevich, V.Lebedev **(***PHOTEK plant of SPC "Integral", Minsk)*
Mass production of high reliable LCDs
Technological features of high reliable LCDs mass production analyzed. Special attention is paid to high reliable control of LCD parameters during and after manufacturing process and operability assurance of a LCD at low temperatures.

October 04, 2006

Session: Emissive Displays

Seminar 1. Electroluminescent Display Technologies

1.5. D. Zajarskiy, O. Ruzanov, D. Fedorkov, V. Petrov, B. Klimov (*Saratov State University, Russia*).

The organic luminescent display with an interior electric field.

The problem of a raise of effectiveness of carrier charge transfer by means of making of an internal field was considered. For this purpose the authors create structures which besides standard layers, such as HTL, ETL contain layers consisting of polymers with the Internal charge, such as PSS, PAN. Theoretical calculations show, that the addition this layers in poly-layers OLED structures can lower potential energy barrier between organic layers and electrodes that will allow to raise{increase} effectiveness of an emission of charge transfer and consequently also number of excitons in working area of the display.

1.6. N.V.Gaponenko (*Belarusian State University of Informatics and Radioelectronics*)
Xerogels, doped with lanthanide ions, in mesoporous matrices: from peculiarities of optical excitation to multicolor luminescent images
The report summarizes the peculiarities of synthesis and luminescence properties of the structures comprising xerogels, doped with optically active erbium, terbium and europium, in porous anodic alumina and artificial opals. Effect of light scattering is matrices with anisotropic density of states is discussed from viewpoint of enhanced luminescence from the structures for blue, green, red and infrared spectral ranges.

Seminar 2. Cathodeluminescent Display Technologies

2.1. N.P. Soschin, V.N. Lichmanova, V.A. Bolshukhin, E.A. Kirillov (*R&D I «Platan», Fryazino, Russia*).

The new phosphors for screens of high-speed CRT.

The parameters of high-speed phosphors are submitted in the table

Phosphor	Spectral inclusion, nm	Power output, %	Particles size, mkm	Decay time, ns
$(Y, Gd, Me)_2SiO_5$:CeYb	390-510	12-14	$d_{50} = 1,0$	40-50
$(Y,Gd,Me)_3(Al,Ga)_5$ CeYb	500-605	12-16	$d_{50} = 2,0$	40-60

The emitting screens were created with high-speed CRT, working with speeds of the information processing in 2-3 times above, than achieved before the values on frequency f=10-20 MHz. (See RF Patent № 2252240. "Blue emitting phosphor on a basis yttrium-gadolinium oxyorthosilicate, activated by Ce 3+ ").

2.2. A.O.Dmitrienko, V.P.Dmitrienko, A.V.Strel'tsov, S.V.Kudryavtsev, S.L.Shmakov (*Saratov State University, Russia*), D-S. Zang, Y.-C. You (*Samsung SDI, Korea*).
Efficient RGB-phosphors: synthesis and peculiarity of cathodoluminescence.
Synthesis techniques for RGB phosphors based on zinc-cadmium sulfides and yttrium-gadolinium oxosulfides effectively excited in CRT screens, middle-voltage and high-voltage (300-2000 V) FED and low-voltage VFD have been developed. The influence of synthesis conditions (blend composition, activator and coactivator concentrations, nature and content of fluxes, annealing temperature and atmosphere etc.) on their brightness, efficiency and chromaticity coordinates has been established.

2.4. N.P. Abanshin, E.G. Mukhina, B.I. Gorfinkel (*R&DI "Volga", Saratov, Russia*).

Development of displays with autoemissive cathodes on the basis of carbon nanotube.
Displays developed on CNT base by an electro-arc dispersion method, are characterized by managing fields 1.5-2 V/microns. Thus brightness of radiation ~1000 cd/m^2. Displays with CNT, received by CVD method, had managing fields 3.4 V/microns at brightness of radiation ~1000 cd/m^2. Tests for the minimal operating time of the developed displays were performed. The analysis of manufacturing techniques and parameters of displays has shown, that CNT display technology, created by an electro-arc method is essentially easier, however durability of CNT displays, received by method CVD is higher.

Session: Non-Emissive Displays

Seminar 1. LCD Technologies – Alignment and Electrooptics

1.3. S. Lazarouk , A. Smirnov, V. Labunov, A. Astafjev (*Byelorussian State University of Informatics and Radioelectronics, Minsk*), A.Maximov, A.Martinovich (*PHOTEK plant, SPC "Integral" , Minsk, Byelorussia*).
LC alignment using nanostructured alumina layers.
A novel low temperature technological method was developed to form nanostructured alumina layers with regulated tilt of porous which can be used for the precise alignment of liquid crystal molecules in LCDs.

1.4. S.V. Pasechnik, D.V. Shmeliova, V.A. Tsvetkov, A.V. Dubtsov, B.A. Shustrov (*Moscow State University of Instrument Engineering & Computer Science, Russia*).

New geometry for a study of weak anchoring in liquid crystals.

A new geometry for a study of both static and dynamic properties of liquid crystal layers, confined by weakly anchoring surfaces. The main advantage of the geometry is the possibility to register extremely slight local azimuth variations of a director induced by electric field and surfaces due to strong changes of the intensity of the light propagating in the plane of the surface under consideration (see fig.). In this case a pure twist-like deformation of a director results in a variation of the angle between the optical axis and the direction of the light propagation. It leads to a strong optical response at an essential value of optical length. The proposed geometry can be useful for a study of such phenomena as breaking off surface anchoring and slow gliding of the easy axes.

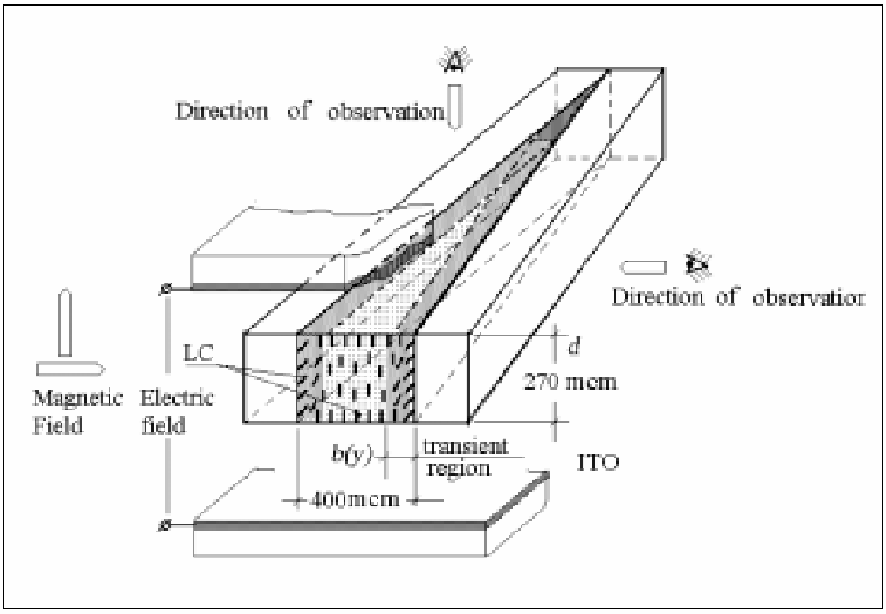


FIGURE: General scheme of the LC cell.

1.5. S. Hirota, S. Oka, O. Itou (*Hitachi, Ltd., Japan*), S. Komura (*Hitachi Displays, Ltd., Japan*).

Advantage of Transflective IPS-LCD Technology for Mobile Applications.

In this paper, we discuss the transflective display performance and the viewing-angle characteristics required for FPDs used in mobile devices. The reflective property of the transflective technology is necessary for desirable visibility under various lighting conditions. The transmissive property is also important for representing photographic-quality images. It is often thought that the viewing-angle characteristics of FPDs are not important because the usage of these mobile devices is usually personal. However, the viewing-angle property is still important for FPDs used in mobile devices to display photographic-quality images.
The authors have developed an IPS-LCD that combines good outdoor visibility and good viewing angle performance.

1.6. S.A. Studentsov, V.A. Brezhnev, N.D. Zhukov (*R&D Institute "Volga", Saratov, Russia*), V.G.Chigrinov, Al. Murauski (*Hong Kong University of Science and Technology*).

Super twist liquid crystal display with 3-d electrodes.

A construction without imperfections typical for passive STN LCD is suggested in this article. Multi-layer 3D electrodes, consisted of conventional electrode on the substrate surface and conducting film on isolating pedestal tops were discussed. Those pedestals are placed between the surface electrode rows or columns like a black mask. The pedestal value is equal to 1/4 - 1/2 of the LC-layer thickness.
3-D electrode on one substrate without any electrodes on another plate is considered. For 180º cell with MLC-6096 (Merck) +1.0% ZLI-811, LC thickness d=4.0-4.5 µm, pitch P_0=10 µm contrast ratio CR is equal to 160:1, total response time is about 20 ms.

Seminar 2. LCD Technologies - Electrooptics and Optics

2.1. E.P.Pozhidaev, A.A.Zhukov, I.N.Kompanets, E.E.Buslova, P.S.Komarov, Yu.P.Bobilev, V.M.Shoshin (*Lebedev Physical Institute of RAS, Moscow, Russia*).

Surface nanostructures of aligning layers as a tool of ferroelectric liquid crystal display cells operation steadiness increasing.

It was shown experimentally that aligning layers on ITO surfaces of liquid crystalline cells at ordinaty spin-coating can be arranged statistically as island nanostructures with typical thickness of islands 3÷15 nm, in plane averaged dimension of islands about 500 nm÷5 μm and an averaged distance between islands about 500 nm÷5 μm also. Variations of mentioned above parameters of surface nanostructures results in schanging of aligning surface polarity and manifests in controlled bistable and multiplex operation steadiness of ferroelectric liquid crystal (FLC) display cells.

2.2. V.A. Loiko, A.A. Konkolovich, P.G. Maximenko (*Institute of Physics of NAS, Minsk, Byelorussia*).

Optical characteristics of polymer dispersed liquid crystal films with fine droplets.

The method to describe scattering cross sections, phase shift, and ellipsometrical parameters of light transmitted through the polymer dispersed liquid crystal films with fine droplets is considered. The parameters listed are connected with the film morphology. The simple equations are derived. They can be used for many display applications, for example phase correction.

2.3. N.A. Ivanova, S.Sh. Shahab, V.E. Agabekov (*Institute of Chemistry of New Materials, NASB, Byelorussia*), O.V. Tsaruk, V.A. Dlugunovich (*Stepanov Institute of Physics, NASB, Byelorussia).*

Optimization of formation method of L-type polarizers on the data of polarimetry and heat conductivity.

In the presentation results of research of two method of formation of polarizing structure of L types polarizers (in “mass” and “in bath”) are presented which have been carried out by Stoks-polarimetry and thermo indicator methods at the first time. Is shown that the first method is preferable as film not only are painted on thickness, but also become more oriented as factor of anisotropy of heat conductivity at them is higher.

2.4. I. Kasianova, A. Krivoschepov, D. Yurchenko, A. Lazarev, P. Lazarev (Crysoptix Ltd, Moscow, Russia), S. Palto (*Institute of Crystallography, RAS, Moscow, Russia*).

New transparent birefringent material for interference polarizer fabrication.

We have developed new non-absorbing birefringent material for Interference Polarizer (I-Polar) fabrication. I-Polar can be used in light recycling systems aimed to improve backlight efficiency and reduce power consumption of the LCD displays. By wet coating the new material onto a substrate we produce anisotropic films with thickness in the range of 60-90 nm. Such thickness range satisfies the condition that optical thickness of layers in the interference polarizer is equal to the quarter wavelength. One birefringent layer of the material coated on glass reflects 14% of polarization orthogonal to the anisotropic film coating direction which corresponds to refractive index in the said direction equal to 1.8, whereas a stack of 5 layers (3 birefringent layers alternated with 2 isotropic ones, refractive index of the latter being equal to the minimum in-plane index of the birefringent layer) on the glass produces 38% reflectance at 550 nm. The designs based on this material for a typical LCD backlight spectrum will be presented.

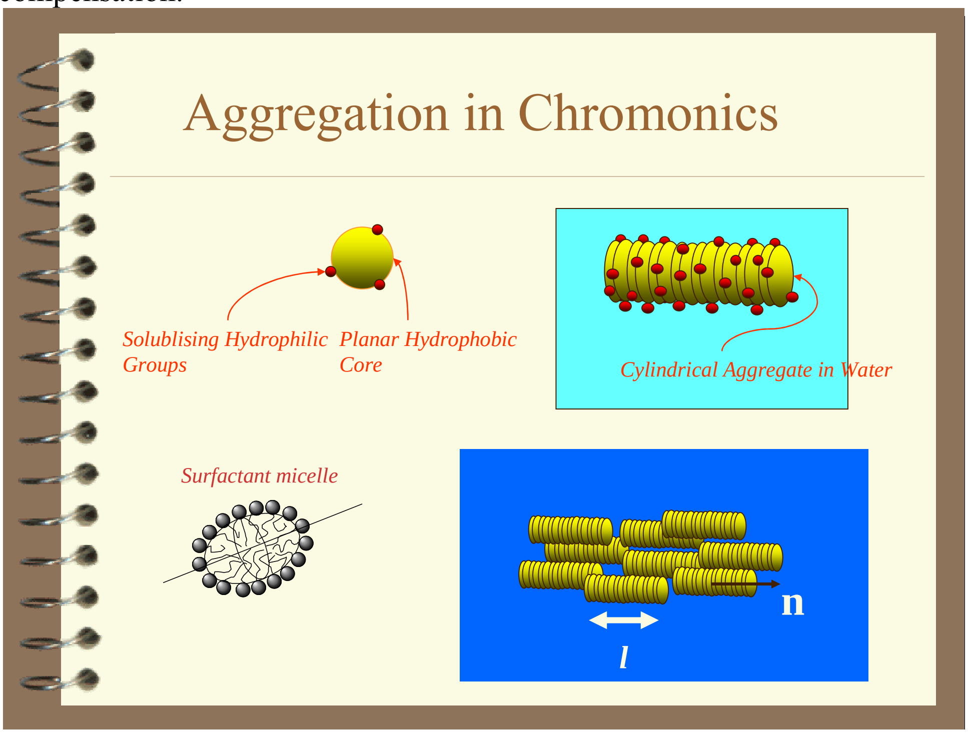
The authors have manufactured a prototype of I-polar (interference polarizer) with reflectance characteristics similar to DBEF. In future they will develop materials with large birefringence (such as *0.6-0.8*).

2.5. A.Lazarev, P.Lazarev, A.Manko, S.Remizov (*Crysoptix Ltd, Moscow, Russia*), S.Palto (*Institute of Crystallography, RAS, Moscow, Russia*).

Cryscade Optical Films: Retarders for LCD.

We have developed a new class of materials and a Cryscade method of manufacturing of the retardation film. Advanced materials comprise the amphiphilic compounds and include salts of carboxylic and sulfonic acids with conjugated aromatic cores, which do not absorb light in visible range of light spectra. The Cryscade method of manufacturing of the crystalline thin films is based on printing from aqueous solution of lyotropic liquid crystal phase. We have produced a set of retardation films that exhibit properties of C-, A-plates and biaxial films. As compared to conventional retardation materials, new retardation films produced with the Cryscade method are strikingly thinner (thickness range is 100 - 1000 nm), whereas birefringence is typically much higher (delta n varies from 0.05 to 0.40). Such a broad range of available thickness and retardation values makes feasible tailoring of LCD designs for customer needs. Viewing angle performance of the crossed polarizers is significantly improved in the presence of the Cryscade retardation films, so that the light leakage at oblique incidence decreases several times. Formation of the new coatable stretchless retardation coatings by a roll-to-roll process can be easily incorporated into the techniques widely used in the LCD industry. The Cryscade retarders are aimed for LCD HTV application and open up opportunities for the manufacturing cost reduction.

Negative A-plate coated onto cellulose triacetate film provides sufficient birefringence for VA cell LCD compensation.



Structure of Cryscade units

2.6. A. Putilin, I. Gustomiasov (*Lebedev Physical Institute of RAS, Moscow, Russia*).

Application of Holographic Elements in Displays and Planar Illuminators.

Holographic Optical Elements (HOE.s) on planar waveguides can be used to design the planar optics for backlit units, color selectors or filters, lenses for virtual reality displays. The several schemes for HOE recording was proposed to obtain planar stereo backlit unit and private eye displays light source. In this paper it is shown that the specific light transformation grating permits to construct efficient stereo backlit units that can be switched to 2D viewing. It is also shown several schemes of reflection/transmition backlit units and scattering films based on holographic optical elements. The performance of the waveguide HOE can be optimized using the parameters of recording scheme and etching parameters.

Poster Session

Emissive Display Technologies

P.2 E.V. Sergeev, L.I. Tarasova-Tarosjan, E.V. Komarov, A.A. Eruzin, M.M. Sychov, E.V. Kolobkova, I.B. Gavrilenko *(Saint-Petersburg State Institute of Technology, Russia*).
Plasma modification of EL phosphor.
Nitrogen plasma modification resulted in *100% improvement of ZnS:Cu,Br EL brightness* at 220V drive. Such result was obtained after treatment in nitrogen at 0.05 torr and 0.250 l/min gas flow.

P.5 I.V. Shein (*ZAO "Almaz-Fazotron, Saratov, Russia*), S.L. Shmakov (*Saratov State University, Russia*).
Electrophoretic Technique with a Thin Electrochemical Cell Driving by Light like a Photoprinting Process: for LED and OLED Screening Application.
Selective illumination of electrochemical planar cell with a capillary gap through masking electrode or by laser locally heats and melts the gel, the dispersion or organic solution is activated electrically, and EPD begins just at the place affected by the light. In this version the technology procedures is looking like *photoprinting*, bat the base of phenomenon is EPD.

P.6 N.P. Soschin, V.N. Lichmanova, V.A. Bolshukhin, E.A. Kirillov (*R&DI «Platan», Fryazino, Russia*).
Use of radiative cathodoluminescence screens for creation of devices of illumination.
Unique many times striped phosphor on a basis oxysulfide yttrium-terbium- of structure Y2O2S: Tb.Tm.Eu was developed in R&D I "Platan". This material provides:
- intensive radiation in dark blue (λ = 470 nm), green (λ = 545 nm) and red (λ = 626 nm) areas of a seen spectrum;
- *very high current linearity of brightness* at significant density of a continuous current of excitation (j=20-100 mA/cm^2);
- average and short time of afterglow, smaller duration of the television staff (t ~ 10^{-2} s);
- Radiating stability of brightness of a luminescence during 10 000 hours of continuous work;
- *High local (10000 cd/m^2) and average (2000 cd/m^2) brightness* of a luminescence.

The demonstration of the LCD-device with cathodoluminescence by back illumination on the international congresses SID-2005 and SID-2006 shows on *perspective of application average volt cathodoluminescence in LCD.* Constructive and technological problems of industrial release of similar devices now are studied.

Non- Emissive Display Technologies

P.8 S.I. Kucheev (*Chernigov University, Ukraine*).
Ion-controlled *liquid crystal grating* in silicon/nematic/ITO structure.
Single crystalline silicon sample with lithographically performed periodical surface .n-n+-structure having (H) depth of n+ pockets is used as one wall in the cell. N-n+-relief difference equal to pair hundreds nanometers does not cause diffraction of laser beam (0.63 µm). Due to

field effect in silicon which is induced by ion charge localized (adsorbed) near silicon surface a depleted layer width (L) in silicon can be changed within some range.

P.15 S.Sh. Shahab, N.G. Ariko, V.E. Agabekov, L.N. Filippovich (*Institute of Chemistry of New Materials, NASB, Minsk, Byelorussia*).
Anisotropy of polarized polyvinyl alcohol films.
Optical anisotropy and anisotropy of heat conductivity are investigated. First parameter is connected to distinction in absorption of two light waves by a film in mutually perpendicular directions, second - with distinction in distribution of heat in a film on these directions. For the first time for uniaxially oriented polyvinyl alcohol films with dichroic organic dyes quantitative correlation between two parameters is carried out.

P.16 V.P. Gerasimov, V.A. Gunyakov, S.A. Myslivets, V.G. Arkhipkin, V.Ya. Zyryanov, V.F. Shabanov (*L.V. Kirensky Institute of Physics of SB RAS, Krasnoyarsk, Russia*), S.Ya. Vetrov (*Krasnoyarsk State Technical University, Russia*), G.N. Kamaev (*Institute of Semiconductor Physics of SB RAS, Novosibirsk, Russia*).
Influence of Incidence and Temperature on Defect Modes in Photonic Crystal Cell with Nematic Layer.
Tunable multilayer photonic crystals (PC) can be formed by the insertion of the nematic LC as a defect layer in periodic structure. Transmission spectra of the PC depend on the orientational and phase states of nematic layer. *These states can be controlled by external factors (temperature, electric field, etc)*, and it makes the PC promising material to be applied in displays. In this work the opportunities of the thermo-optical technique as well as the oblique incidence of light have been studied to control the transmission spectra of the one-dimensional PC cell. The PC considered structure forms the photonic band gap in the visible range of the transmission spectrum with a set of the localized modes whose positions depend on the dielectric properties of PC layers and the incident angle. Transformation of the PC transmission spectrum seems to result from the change of the refractive indices of the nematic caused by variation of both temperature and incidence angle. The numerical simulation of the spectral characteristics agrees well with the experimental data.

P.17 G.M.Zharkova, A.P.Petrov, I.V.Samsonova, S.A.Strel'tsov (*Institute of Theoretical and Applied Mechanics, SB RAS, Novosibirsk, Russia*).
Holographic polymer-LC arrays.
Composites based on photosensitive polymers and liquid crystals attract an interest of researches to use such composites as an *optical medium for storage and display* of optical information, in particular in *microdisplay t*echnologies. One of the most promising way of the storage information in such media is holographic method. This method allows to fabricate composites with nanostuctured units (for example, diffraction grating), what leads to the improvement of the dynamic and contrast parameters. The presence of anisotropic liquid crystalline phase in the composites allows to manage its optical properties. Theoretical and experimental results concerning to the investigations of the *diffraction gratings, formed on the base of the original photopolymeric liquid crystalline composite* were presented. The polarization dependence of diffraction efficiency, angular selectivity, as well as switching time and volt-contracts characteristics presented also.

P.18 V.Kourmachev, Yu. Timoshkov, T. Orechovskaya, V.Timoshkov (*Minsk Institute of Management, Byelorussia*).
Novel way of fabrication of microreliefs for MEMS.

Main goal of this work was the *fabrication of microreliefs by using of composite materials instead of homogeneous metals*, i.e. co-deposited metal matrix with inert ultra-fine particles by electrolysis or plating processes. Microrelief structures were produced and tested. The obtained results will be presented and analyzed.

Display Systems and Applications

P.19 K. Karapetyan, A. Morozov, M. Potapova (*Samsung Research Center, Moscow*).
Beam reshaping for rectangular area illumination.

P.20 K. Karapetyan, A. Morozov, M. Potapova (*Samsung Research Center, Moscow*).

Multiple PC-based simulation of complex illumination system using TracePro and MATLAB.