CeNS

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2016

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CENTRE FOR NANO AND SOFT MATTER SCIENCES

Autonomous Institute under the Dept. of Science and Technology, Govt. of India

... in pursuit of Global excellence in Science and to nurture Indigenous Technology for the betterment of Our Country.

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ABOUT CeNS

The Centre for Nano and Soft Matter Sciences (CeNS) is an autonomous research institute under Department of Science and Technology (DST), Government of India. DST provides core support to the Centre in the form of a grant-in-aid for conducting basic and applied research in nano and soft matter sciences. CeNS is located in Jalahalli, Bengaluru.

It was established in 1991 as Centre for Liquid Crystal Research by eminent liquid crystal scientist Prof. S. Chandrasekhar, FRS. In 1995, it became an autonomous institute under the Department of Electronics (DOE), Government of India and in 2003 was brought under DST. Subsequently in the year 2010, the name was changed to Centre for Soft Matter Research. Recently, in 2014, the Centre has further widened the scope of research activities to embrace nano science and technology and is now known as Centre for Nano and Soft Matter Sciences (CeNS). It is being mentored by Nano-Mission of Government of India.

The Centre is engaged in Materials research at all relevant length scales. Specifically, the current activities are focused on a variety of metal and semiconductor nanostructures, liquid crystals, gels, membranes and hybrid materials. The researchers strive to take the in-house inventions towards technology realisation. The Centre has close interactions with many Institutions and Industry, in India and abroad.

CeNS is housed in the BEL campus, Jalahalli and is surrounded by lush greenery dotted with beautiful flowering trees. The ambience is ideal for the research community to carry out the activities in a serene atmosphere. The campus is being expanded on a 14 acre site at Shivanapura, Bengaluru North.

SHIVANAPURA CAMPUS

The Department of Science and Technology, Government of Karnataka has allocated a 14-acre land at Shivanapura, Bengaluru North. CeNS is building its new campus on this land to promote new age science with focus on nanoscience and technology. State of the art educational infrastructure and research units for soft- and nano-science will form the heart of the campus that will be include an administrative wing, a modern library, prototype exhibition hall, auditorium, discussion rooms, residential blocks, hostel and cafeteria. The goal is to create a perfect ambience for learning and practicing science that would smoothly translate to technology realization for the benefit of the society at large.

Pristine land

The foundation-stone of the new campus was laid by Bharat Ratna Prof. C. N. R. Rao, Chairman, Governing Council, CeNS on 1st August 2016 in the presence of Governing Council members and other dignitaries.

An artist's impression of the future campus

GOVERNING COUNCIL

Professor C.N.R.Rao, FRS

CHAIRMAN

National Research Professor and Honorary President & Linus Pauling Research Professor
Jawaharlal Nehru Centre for Advanced Scientific Research
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MEMBER SECRETARY

Professor G. U. Kulkarni
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RESEARCH ADVISORY BOARD

CHAIRMAN

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Professor, Solid State and Structural Chemistry Unit
Indian Institute of Science, Bengaluru 560 012

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DIRECTOR

G. U. Kulkarni, FNASc, FASc

FACULTY

Scientist G

S. Krishna Prasad

Scientist E

Channabasaveshwar V. Yelamaggad
Geetha G. Nair
D. S. Shankar Rao
Veena Prasad

Scientist D

S. Angappane
Neena S. John
Pralay K Santra
P. Viswanath

Honorary Professor

K. A. Suresh, FNASc, FNA

Dr. H. S. R. Matte will be joining the Centre shortly as Scientist C.

RESEARCH ACTIVITIES

At nanoscale, matter behaves differently, depending sensitively on the size and shape. Soft on the other hand, stands for interactions at relatively longer length scale and the combination, Nano and Soft, essentially signifies the overall control on wide ranging material properties, be it electronic, optical, magnetic, thermal, mechanical or rheological. Thus, the research activities in the Centre are focussed on realizing nanomaterials through novel synthetic methods, manipulation and control of material properties and translating them to potential products by up-scaling and prototyping. The researchers at the Centre work in close collaboration to realize a comprehensive picture of the materials in addition to broadening the scope of the scientific activities. The collaboration extends to other scientific groups, in India and abroad, resulting in dissemination of knowledge and publication of important papers.

RESEARCH HIGHLIGHTS

- Photo-driven change in the polar environment tunes gelation in a nematic LC
- Twisted Graphene stacks
- Fast electrically switchable anisotropic photoluminescence in a guest-host system
- RGO-metal/metal oxide films as reusable SERS substrates for dyes
- Polymer stabilization of bent core nematic
- Exchange bias and magnetoresistance effects of magnetic nanoparticles
- Textured nanocrystalline films
- Covalent organic frameworks / metal-organic hybrid frameworks
- Diminished temperature-independent nematic splay elastic constant on gelation.
- Unusual forms of Gold
- Gold nanorod/nematic composites
- Resistive switching in Ag/ZnO/Pt device
- Quantum Dot (QD) photovoltaics
- Superlattice structure and crystallite orientation in quantum dot solids
- Binary LC system exhibiting N-NTB transition
- Viscoelastic behavior of composites of strongly polar bent- and rod-like nematic molecules
- Influence of nanoparticle network on the activation enthalpy in the N phase under isobaric/isothermal conditions.
- Charge transport in a LC triphenylene polymer monolayers at interfaces
- Hockey- stick shaped azo compounds
- Annealing assisted polymorphism in LB films of metallo-phthalocyanine
- Dilatational rheology of a ferroelectric copolymer at the air-water interface
- Supramolecular devices
- Transparent & flexible electronics

RESEARCH GRANTS

The centre, in addition to the annual grants from DST, received extramural funding from SERB, Indo-Bulgarian Bilateral, DST-WOS (A) and Nanomission (TPF-Nano) projects.

INDUSTRY INTERACTION

Tata Steel Advanced Materials Research Centre:

Tata Steel signed a memorandum of understanding (MoU) with the Centre to set up TSAMRC at CeNS. This initiative is in the light of Tata Steel being entrusted with the responsibility of developing a long-term strategic roadmap in the area of advanced materials.

Scientists also have collaborative R&D project activities engaging other industry partners such as Hindusan Petroleum, Hind High Vacuum and Bharat Electronics.

PROTOTYPE GALLERY

With an objective to showcase the Centre's research activities and to set meaningful dialogue with Industry visitors, prototypes (listed below) based on in-house inventions are displayed in the gallery.

- Graphene coated quartz plates
- Corrosion Protective Coating for Copper
- Fast Responding Anisotropic Organogels
- Fog-on Demand(Electrically Switchable Transparency)
- Triboelectric Nano Generator
- Breath Rhgram
- Self-heated Cover slip
- Flexi Touch Display
- Defrosting Panels
- Defogging Panels
- Light Modulating Smart Window
- Invisible Switches

Each prototype is demonstrable/interactive, aided by a poster with technical explanations. The items on the shelf are periodically replaced with new ones after a time period or following technology transfer.

Contact: prototype@cens.res.in

S ANGAPPANE obatined his Ph.D. (2004) from Indian Institute of Technology (IIT) Madras. He did his post doctoral work at Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru and SungKyunKwan University, Korea, before joining CeNS in 2008

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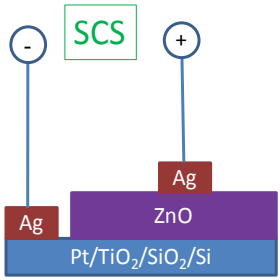
RESEARCH INTERESTS

Oxide nano electronics; ZnO and related materials; Perovskite solar cells; Colossal magnetoresistance manganites; Multiferroics

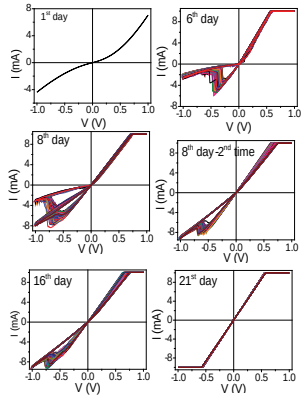
RESEARCH HIGHLIGHTS

Resistive switching in Ag/ZnO/Pt device



We have taken up the systematic study of resistive switching of Metal/ZnO/Pt devices with Ag or Al top electrodes.

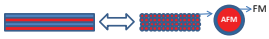
Stability of the device studied under the laboratory ambience.



Resistive switching (I-V characteristics) study of Ag/ZnO/Pt device from 1st day to 21st day.

Exchange bias and magnetoresistance of magnetic nanoparticles, such as, NiO, doped NiO

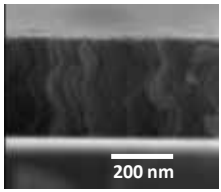
AFM/FM core/shell nanoparticles exhibit exchange bias as well as the MR typical of AFM/FM multilayer films



We study the cold pressed compacts of NiO:Ni nanoparticles showing both exchange bias and MR properties.

Textured nanocrystalline films

Nanostructures formed by Glancing angle deposition (GLAD) using sputtering are being studied for solar cell applications.



PhD Students
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Subir Roy

Project Assistant
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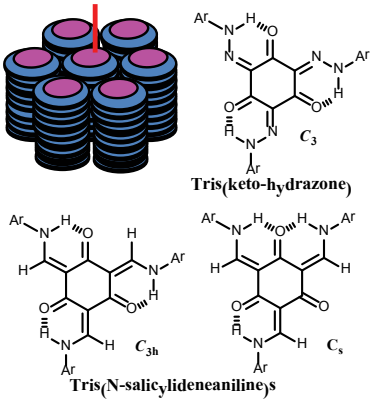
C V YELAMAGGAD obtained his Ph.D. (1992) in Chemistry from Karnatak University. He was a post doctoral fellow at Indian Institute of Science, Bangalore and at National Chio Tung University, Taiwan before joining CeNS in 1997.

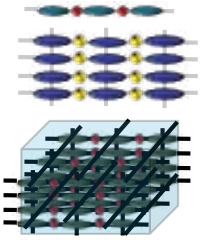
http://www.cens.res.in/Faculty/Details/Yelamaggad

RESEARCH HIGHLIGHTS

Discotic liquid crystals for electronic devices

The molecular design and synthesis of organic materials suitable for thin-film electronic devices are pursued actively. In particular a range of discotic (disk-like) liquid crystals (LCs) capable of exhibiting columnar (Col) phase well below and above the room temperature have been realized. Such discotics derived either from tris(keto-hydrazone) or tris(N-salicylideneaniline) cores show promising photoluminescence and redox behaviour. These motifs with n-type / p-type characteristics are expected to serve as the ideal media for making prototype thin-film organic solar cells.



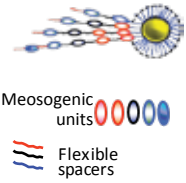


Mesoporous & macroporous motifs for various proto-type devices

We are engaged in the strategic design, synthesis and characterization of mesoporous and macroporous materials such as covalent organic frameworks, metal-organic hybrid frameworks including coordination polymers incorporating a wide range of organic-ligands and metal-centres. Owing to their potential as functional materials, featuring 1D, 2D, or 3D architecture, may find applications in various device fabrications.

Metal nanoparticles (MNPs) functionalized with LCs

One of our recent studies involves binding of NPs with multifunctional oligomeiric LCs to realize single-component LC-NP hybrids. These thermotropic hybrids show the properties of polymers, while still retaining the fluidity and anisotropic properties of the low molar mass LCs as well as NPs. Thus they have the potential to generate multifunctional networks capable of serving as vital media in wide range of applied and fundamental research areas.



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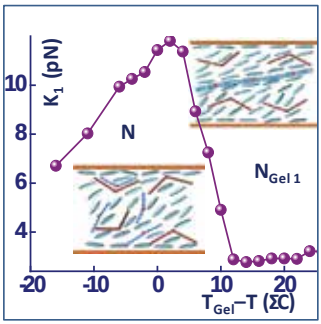
GEETHA G NAIR is a Ph.D. (1993) in Physics from Raman Research Institute (RRI), Bengaluru. She was a Post Doctoral Fellow at RRI and later worked as a visiting scientist at Kent State University, USA. Currently she is working as a scientist at CeNS.

http://www.cens.res.in/Faculty/Details/Geetha

RESEARCH HIGHLIGHTS

A bent-core-rich NLC exhibiting diminished, temperature-independent splay elastic constant on gelation.



Liquid crystal gels with bent-core-rich nematic liquid crystal (NLC) as the carrier fluid and a low molecular weight organic compound as the gelator are studied. The gel fibers having plastic crystalline order in the "weak" nematic gel phase (NGel1) manifests itself in a substantial lowering of the Frank elastic constant (K11) associated with the nematic director deformation of the splay kind. This effect is strong enough to annul the order parameter controlled enhancement of K11, a feature that is important from the view point of low threshold optical devices.

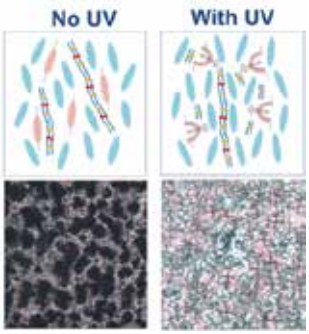


Photo-driven change in the polar environment tunes gelation in a nematic liquid crystal.

The effect of UV light on a photo-responsive NLC gel is investigated using dielectric spectroscopy. The results demonstrate gelation getting substantially influenced by light. The effect is due to the change in polar solubility parameter of the gelator environment brought about by UV illumination. FTIR, Raman and rheological data support the observed feature. The attractive aspect is that, the "bright" planar and "dark" homeotropic states obtained with and without light respectively could not be erased until the gel network melts. This phenomenon makes the system viable to be used in permanent optical data storage applications.

PhD Students
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G U KULKARNI obtained his Ph. D (1992) in Solid State and Structural Chemistry from Indian Institute of Science. He was a post doctoral fellow at Cardiff University, UK, before joining Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) in 1995. He took charge as Director, CeNS in April 2015.

http://www.cens.res.in/Faculty/Details/Kulkarni

RESEARCH HIGHLIGHTS

TRANSPARENT & FLEXIBLE ELECTRONICS: Visibly transparent yet electrically conducting materials are rare. Conventionally used tin doped indium oxide is quite expensive. Transparent conductors made from our invention, invisible metal nanomesh, provide affordable solutions besides adding many novel features. Using nanomesh electrodes, many optoelectronics and optoelectrical devices have been fabricated including touchscreens, EMI shields and smart windows.

See: ACS Appl. Mater. Inter., 8, 12559 (2016).

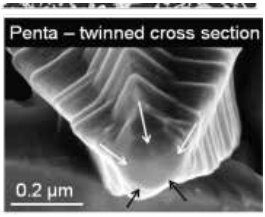
TWISTED GRAPHENE STACKS: The extraordinary properties of graphene are truly observable when it is suspended, being free from any substrate influence. In this work, a new type of multilayer graphene system has been made wherein each layer is turbostratically decoupled, resembling the suspended graphene, while maintaining high degree of 2D crystallinity.

See: J. Phys. Chem. Lett., 6, 4437 (2015).

UNUSUAL FORMS OF GOLD: Inducing lattice strain in crystals may cause structural transformation and the same has been achieved in the case of gold, by stabilizing nanocorrugated morphologies. This 'microrice gold' is more nobler than the conventional gold; it stands aquaregia and mercury treatments and exhibits interesting catalytic properties!

See: Nano Research, DOI: 10.1007/s12274-016-1417-y (2016).

SUPRAMOLECULAR DEVICES: Supramolecules particularly in the form of nanofibres offer advantages in electrical transport as they are essentially 1D systems. Using nanofibres built via self-assembly of donor and acceptor molecules, high mobility FET, supercapacitors and ultrafast humidity sensors have been fabricated. The latter have been applied to measure humidity in human breath dynamically.



See: ChemNanoMat (DOI: 10.1002/cnma.201600319).

Also see: http://www.jncasr.ac.in/kulkarni/

PhD Students

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Research Associates

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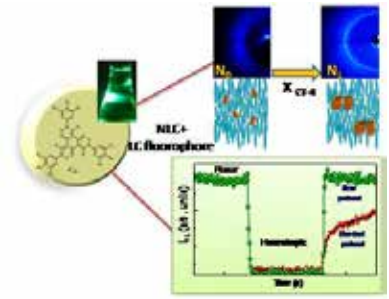
Umesha Mogera

S KRISHNA PRASAD got his Ph. D. (1987) in Physics from Raman Research Institute (RRI), Bengaluru and did his Post Doctoral studies at the Technical University, Berlin. He worked as a scientist at RRI before joining CeNS in 1995.

http://www.cens.res.in/Faculty/Details/Prasad

RESEARCH HIGHLIGHTS

Fast Electrically Switchable Anisotropic Photoluminescence in a guest-host system

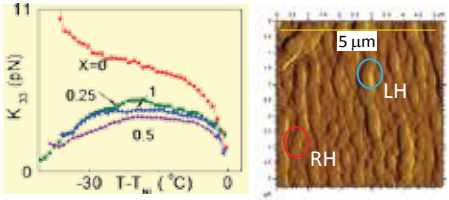


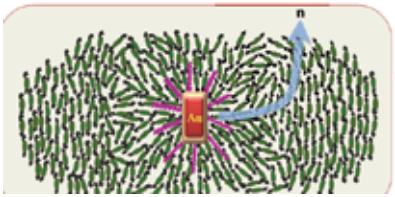
- New protocol for Fast PL Switching
- Fatigue-free flipping between two PL states
- Enhanced short-range structure

Field-driven PL device

Polymer stabilization of bent core nematic

- Local (nematic-like) elasticity controlled by the confiner-elasticity
- Short strands lower the elasticity compared to pure LC
- Non-monotonic dependence of threshold voltage Helical fibres in an achiral system!
- Locally chiral, Globally achiral: Transfer of chirality





Gold nanorod/nematic composites

- Large reduction in magnitude and thermal variation of Frank elastic constants
- Advantages of incorporating nanorods with photofunctionality

PhD Students
Marlin Baral
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NEENA S JOHN obtained her Ph.D. (2007) in Materials Chemistry from Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru. She did her post doctoral work at the University of Manchester, U.K. and Indian Institute of Science, Bengaluru before joining CeNS in 2010.

http://www.cens.res.in/Faculty/Details/Neena

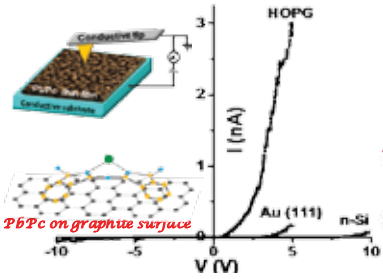
RESEARCH HIGHLIGHTS

Graphene based nanocomposites have gained significance due to their improved properties arsing from the synergic effect of the components. Synthesis of reduced graphene oxide (rGO) and hybrids of rGO with various metal and metal oxide nanoparticles by chemical routes are explored. Thin films of the above materials that are continuous up to mm scale lengths at the constrained environment of a liquid/liquid interface have been realized. Morphology control of the nanoparticles is achieved by varying the synthesis conditions and surfactants. The potential applications of these materials in catalysis, photovoltaics and surface enhanced Raman scattering are also studied.

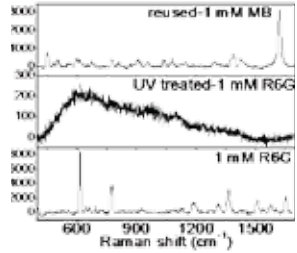
Chemical routes for the preparation of other 2D materials are also of interest.

The hybrid films have been explored for electrochemical sensing of dyes, electrochemcial capacitance and electro catalysis.

The current-voltage characteristics of thin films of metallophthalocyanines are investigated by current sensing-atomic force microscopy and can be correlated with molecular orientation. They are explored for gas sensing studies as well. Hybrids of graphene with these molecules are investigated as supercapacitors.



Molecular orientation and conductance



rGO-metal/metal oxide films as reusable SERS substrates for dyes

PhD Students

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Priya Madhuri K
Alex C
Ramya Prabhu

Research Associates

Indu Pandey

PRALAY K SANTRA obtained his M.S. (2006) and Ph.D. (2011) from Solid State and Structure Chemistry, Indian Institute of Science, Bangalore. He worked as postdoctoral research assocaite at University of Notre Dame, USA and Stanford University, USA. He spent one year as Carl Tryggers fellow at Uppsala University, Sweden before joining CeNS in November 2016.

http://www.cens.res.in/Faculty/Details/Pralay

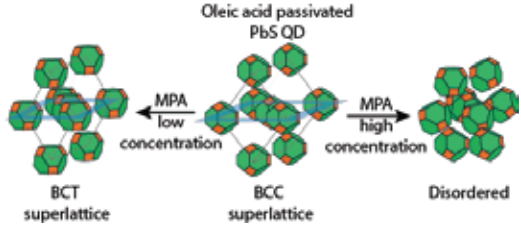
RESEARCH HIGHLIGHTS

Quantum Dot (QD) photovoltaics

Quantum dot solar cells have gained much attention as they show promise toward next generation photovoltaic devices. The overall photovoltaic properties of quantum dot solar cells can be improved by controlling interfacial recombinations by doping and band enginnering of quantum dots using dipole moment of the passivating ligand molecules.

Superlattice structure and crystallite orientation in quantum dot solids

In order to employ the quantum dot solids in electronic devices, individual quantum dots must be electronically coupled with each other to facilitate charge transport in the solid. Oriented attachment of QDs within the quantum dot solid improves interdot coupling while maintaining the quantum confinement. The arrangement and orientation of the QDs within quantum dot solids are controlled by ligand interactions with different facets of QD crystallites.



Photoelectron spectroscopy of photovoltaic materials

X-ray photoelectron spectroscpy is ideally suited to study the chemical composition, oxidation states and electronic properties of different materials. The use of hard x-ray photoelectron spectroscopy (HAXPES) allow to study of the bulk properties rather than just the outer surface. Both synchrotron and lab based photoelectron spectroscopy are employed to elucidate internal heterostructure and electronic properties of relevant photovoltaic nanomaterials.

Atomic Layer Deposition (ALD)

ALD is an unique thin film deposition technique based on gas phase reactions and can be used to different materials with high conformity and uniform thickness. The growth processes of different dielectric materials are being developed.

PhD Students

Anamul Haque

D S SHANKAR RAO obtained Ph. D. (1994) in Physics from Raman Research Institute, Bengaluru. He worked as a Post Doctoral fellow at Samsung Advanced Institute of Technology, Seoul, South Korea before joining CeNS in 1995.

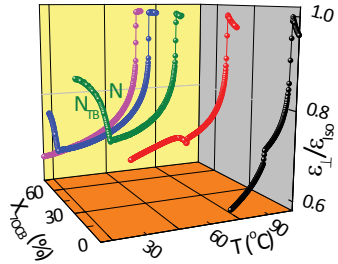
http://www.cens.res.in/Faculty/Details/ShankarRao

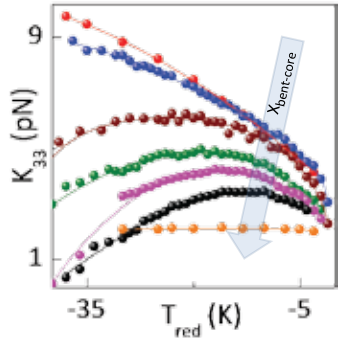
RESEARCH HIGHLIGHTS

Binary system exhibiting twist bend nematic phase transition

Existence of NTB even with high loading of rod-like component

Clear signature in permittivity across with trend reversal for higher content of rods

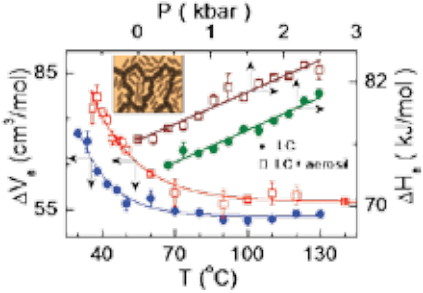




Viscoelastic behavior of composites comprising strongly polar bent-core and rodlike nematic molecules

Convex shaped anomaly in the thermal variation of bend elastic constant, a feature plot which is absent for the pure compounds.

Influence of nanoparticle network on the activation enthalpy activation /volume (DVa) in the N phase under isobaric/ isothermal conditions.



PhD Students
Srividhya Parthasarathi
Varshini G.V

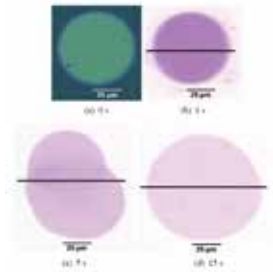
Research Associate
S.R Srither

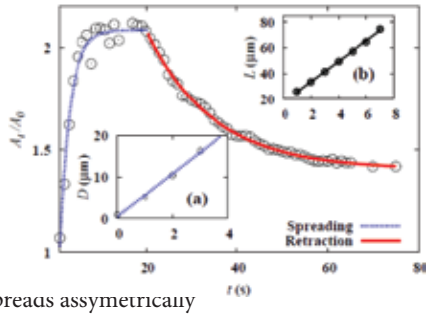
KATTERA A SURESH obtained his Ph.D.(1979) at Raman Research Institute, Bengaluru. He did his post doctoral work at College de France, Paris. He worked as a Research Scientist at Dowell Schlumberger, St. Etienne, France and then he was a Visiting Scientist at Carnegie Mellon University, Pittsburgh, USA. He was a Senior Professor at Raman Research Institute, Bengaluru before joining CeNS as the Director in 2007. Currently he is an Honorary Professor at CeNS.

http://www.cens.res.in/Faculty/Details/Suresh

RESEARCH HIGHLIGHTS

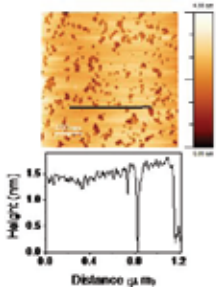
Spreading and retraction dynamics of dye doped liquid crystal domains at air-water interface

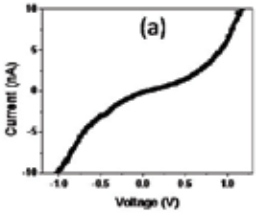


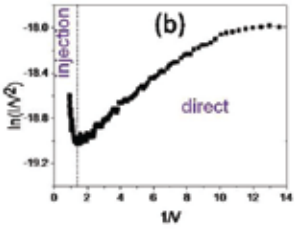


- Under illumination the domain spreads assymetrically
- The domain size increases during spreading to about 2.2 times and then under retraction decreases to 1.4 times its initial size

Electrical conductivity in Langmuir –Blodgett films of n- alkyl cyanobiphenyls







- Cyanobiphenyl forms a uniform monolayer of thickness 1.5 nm
- The analysis of the I-V curve indicates a transition from direct tunneling to injection tunneling

PhD Students
Arup Sarkar

VEENA PRASAD did her Ph.D. (1994) in Chemistry at Raman Research Institute (RRI) , Bengaluru. She was a post-doctoral fellow at RRI before joining CeNS in 1995. She was a visiting scientist at Kent State University, USA.

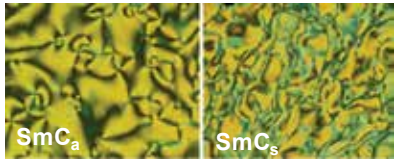
http://www.cens.res.in/Faculty/Details/Veena

RESEARCH HIGHLIGHTS

Hockey- stick shaped azo compounds

As the molecular architecture plays an important role in liquid crystalline compounds, the designing of a mesogen, such as selection of different cores, linking groups and terminal substituents is a challenge to a chemist. Thus, it is quite interesting to study structure – property relationship of different types of compounds. Our literature survey revealed that azo substituted hockey-stick mesogens are seldom known. Such compounds gain importance due to their photo-switching properties. Thus, in the present study we investigated several azo substituted hockey-stick compounds with an aim to study their structure-property relationship with respect to different types of linkage groups and their direction of linking. The newly synthesised compounds were characterised using chemical spectroscopy and their mesomorphic properties were investigated using polarising optical microscopy, differential scanning calorimetry and X-ray diffraction studies. They exhibited a variety of mesophases such as nematic, smectic A, anticlinic smectic C (SmCa), B1 etc. Interestingly, in one of the compounds, the occurrence of two polymorphic tilted smectic phases i.e., SmCs and SmCa are observed. From the experimental observations, we found that only the compounds with five phenyl rings are mesogenic. If the –N=N- linkage is directly attached to the central phenyl ring, the compounds are non-mesogenic, unlike our previous observations in the case of bent-core azo compounds. It is very clear from our investigations that the effect of direction of linkage groups have a major impact on the mesomorphic properties than the different types of linkage groups. This is in agreement with our previous findings in bent-core azo compounds.

Interestingly, the nematic phases of these hockey-stick compounds exhibited only 2-brush disclinations and the d-value obtained in this mesophase was much smaller than the actual molecular length.



PhD Students
Monika M.
Rekha S. Hegde

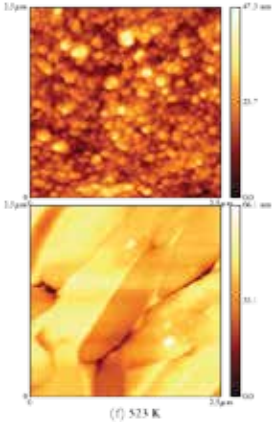
P VISWANATH obtained his Ph.D (2004) in Physics from Raman Research Institute, Bengaluru. He did his post doctoral work at Laboratoire Interdisciplinaire sur l'Organisation Nanometrique et Supramoleculaire, France and at the Max Planck Institute for Colloids and Interfaces, Germany before joining CeNS in 2008.

http://www.cens.res.in/Faculty/Details/Viswanath

RESEARCH HIGHLIGHTS

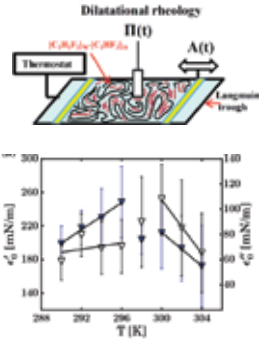
Annealing assisted polymorphism in LB films of metallo-phthalocyanine

Annealing effects on thin Langmuir--Blodgett (LB) Films of Nickel(II) 1,4,8,11,15,18,22,25- octabutoxy -29H,31H phthalocyanine (NiPc(OBu)8) is investigated. DSC studies reveal an enantiotropic transition in bulk powdered samples. X-ray studies on LB film of NiPc(OBu)8 reveal a discontinuity in lattice spacing. Surface morphology of NiPc(OBu)8 film obtained using atomic force microscope show, with annealing, a transformation from spherical granular to elongated, flat crystallites suggesting asymmetric growth process. Our studies show that annealing results in the transformation of a meta-stable polymorph to a stable polymorph.



Dilatational rheology of a ferroelectric copolymer at the air-water interface

Dilatational rheology of a Langmuir film of a ferroelectric copolymer, poly (vinylidene fluoride trifluoroethylene), under various surface pressures, temperatures and frequencies is studied using the oscillatory barrier technique. Both Fourier transform and Lissajous curve methods were used to extract the viscoelastic moduli corresponding to the fundamental mode and nonlinear parameters during the compression and expansion cycles, respectively. Fixing the angular frequency (at small strain regime), the temperature sweep studies on the film at the air-water interface show a pronounced discontinuity in dilatational moduli at 298 K suggesting an order-disorder phase transition.



PhD Students
Chandan Kumar
Brindhu S Malani
Prashanth Nayak

Research Associate
Bharat Bhushan

ACADEMIC PROGRAMME

Ph D PROGRAMME

The Centre is recognised by Mangalore and Manipal universities for the PhD programme. The students, who join for the programme at the Centre, obtain their degree awarded by either of these universities.

ADMISSIONS

Applications are called for PhD programme generally during March/April. However, candidates may apply anytime during the year and such applications will be processed from time to time. Eligible candidates who have cleared the Masters programme in Physics/ Chemistry/Materials Science/ Nano Science and Technology and also qualified in CSIR-UGC NET (JRF) / GATE / JEST examinations or INSPIRE Fellows, are encouraged to apply. The application form can be downloaded from the website of the Centre.

http://www.cens.res.in/Home/Ph-D-programme

COURSE WORK

CeNS offers a variety of credit courses to students who have enrolled for their Ph D. The courses are broadly grouped under five different categories: Instrumental methods & analysis, Scientific communication, Intellectual property, Safety & waste management and Nano-Soft. The topics are taught by the CeNS faculty as well as experts invited from other organisations. To complete the requirement of twelve credits, the rest of the courses are taken at IISc and/or JNCASR.

SEMINARS

During the PhD programme, students deliver Journal-based-Seminar , Thematic Seminar and Thesis Colloquium.

STUDENTS

Ph D STUDENTS

Alex C.
Anamul Haque
Arup Sarkar
K. Bramhaiah
Brindhu Malani S
Chandan Kumar
Gaurav Shukla
Indrajit Mondal
Madhu Babu Kanakala
Marlin Baral
Monika M
Pragnya Satapathy
Prashanth Nayak
Rajashekhar N. Pujar
Sruthi Rose Tom
Priya Madhuri K
Ramya Prabhu
Rekha S. Hegde
Sachin A Bhat
Srividhya Parthasarathi
Subir Roy
Suman Kundu
Sunil Walia
Vaisakh V.M
Varshini G. V.
B. N. Veerabhadraswamy
Vimala S

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Bharat Bhushan
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Indu Pandey
Umesha Mogera

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Arun D.
Prasanna M.
Navaneet Deshpande
Madanmohan Raju

WOS-A SCIENTIST

Uma S Hiremath

PROJECT ASSISTANT

Ravishankar Sugumar

LABORATORY FACILITIES

CHARACTERIZATION LAB (C-LAB)

C-lab houses several equipments providing advanced material characterization capability.

- Atomic Force Microscope
- Field Emission Scanning Electron Microscope with EDX facility
- X-Ray Diffractometer
- Raman Microscope
- UV-VIS-NIR Spectrometer with integrated sphere
- Fluorescence Spectrometer
- UV-VIS-NIR Spectrometer

DEVICES AND INTERFACES LAB (Di-LAB)

Di-lab facilitates the device fabrication studies

- Sputtering deposition system
- Thermogravimetric/Differential thermal analysis
- Thermal evaporation system
- Reactive ion etching system
- Probe station
- Semiconductor characterization
- Contact angle Meter
- Electrochemical work System
- Projection lithography
- Mass spectrometer
- Clean room, wet bench with lamellar flow filters

OTHER EQUIPMENT

• Differential Scanning Calorimeter • Elemental Analyzer • High Speed Centrifuge • High temperature furnaces • Imaging Ellipsometry • Impedance and high-resolution Gain Phase Analysers • Interfacial Rheometer • Langmuir-Blodgett (L-B) trough / Alternate layer L-B trough • Physical Vapour Deposition Unit • Polarizing and laser scanning confocal microscopes • Reflection/Fluorescence microscope • Rheo-Dielectric / Magnetic / Microscopy devices • Rubbing machine • Sapphire-cell High-Pressure apparatus • Resistance / Magneto-resistance measurements • Spin Coating Unit • SQUID Magnetometer • Wet Chemistry Lab • X-ray Diffractometers with image-plate and scintillation counter detectors

FACILITIES

LIBRARY: The Library is automated based on the open source software Koha. Besides subscribing to print version of select journals, it provides access to several e-journals and databases. Through National Knowledge Resource Consortium (NKRC) a plagiarism detection software (iThenticate) is made available.

LECTURE HALL: The Centre has a well equipped auditorium to conduct seminars and meetings with all modern facilities.

MAHAMANA CONFERENCE HALL: The hall is used for mini conferences and board meetings. It has the state-of-the-art audio-visual facilities with provision for video conferencing.

STUDENTS' HOSTEL: The students' hostel, located ~ 2 km from the Centre, has bus stand, hospital, restaurants, banks and other such amenities within easy reach. A free shuttle service operates between CeNS and the hostel .

GUEST HOUSE: The Centre has a well equipped guest house to accommodate academic visitors, and is located in the same premises as the students' hostel.

DINING: A functional and aesthetically appealing dining facility located in the campus serves breakfast and lunch.

OUTREACH PROGRAMME

RESEARCH OUTREACH INITIATIVE (ROI)

The Research Outreach Initiative (ROI) programme was launched last year to provide a first-hand experience in front-line research to highly motivated students presently pursuing a post-graduate course in Physics/Chemistry/Materials Science. The programme has been well received by the student community resulting in many interesting research outcome.

V4 : SCIENCE PROGRAMME@CeNS

This science initiation programme of the Centre aimed at students studying in the high school/+2 level with a view to stimulating and nurturing scientific curiosity in the young minds has become quite popular.

SCIENCE DAY

The National Science Day is celebrated at the Centre as an "Open day". To commemorate the event, students from schools are invited to the Centre and encouraged to interact with the researchers to have a firsthand experience of different scientific activities. A talk by a well-known scientist and visits to the lab by students form the highlights of the Day.

SPECIAL LECTURES

MEMORIAL LECTURE

The Chandrasekhar Memorial Lecture is arranged annually to commemorate the birthday (6th August) of Prof. S. Chandrasekahr, who founded the Centre, then known as CLCR.

TEACHERS' DAY

The Centre celebrates Teachers' Day on 5th September as a mark of tribute to the contribution made by teachers to the society by treating the students and teachers from neighbouring schools to a special lecture and guided lab tour.

DR. ABDUL KALAM'S BIRTHDAY

Declared as "World Students' Day" by the UN, Dr APJ's birthday on15th October is celebrated at the Centre by arranging a special lecture.

C.V. RAMAN'S BIRTHDAY

On 7th November every year CeNS celebrates Sir C.V. Raman's Birthday by arranging an invited lecture by a distinguished scientist.

OTHER EVENTS

Some of the other annual events at CeNS include "Independence Day", "Hindi Diwas", "International Womens' day", "Yoga Day", "Freshers' Day", "Vigilance Awareness Week", "Karnataka Rajyotsava" to name a few.

ADMINISTRATIVE AND TECHNICAL STAFF

Administrative Officer
Subhod M. Gulvady

Accounts Officer
Vivek Dubey

Office Superintendent
P. Nethravathi

Assistant
Jayaram M.

Library Assistant
Nayana .J

Technical Assistants
Sandhya D. Hombal
Sanjay K. Varshney

Public Relations & Maintenance
S. Deepak

Temporary Staff (Admin/Accounts/Purchase)
Adithi H.M.
Bindu S
U.V. Jyothi
Madhura Hegde
Manasa K.R.
Manjunatha
Ranjita Bhat
Reetu K
Veena V

Support
V.K.Jayaprakash
V.Samuel Hebich

Support (Temporary)
Ningappa Kadimani
Prahlad D.G.

R&D Assistants (Temporary)
Arun D.
Madanmohanraju
Navneet Deshpande
Prasanna M.

MAINTENANCE STAFF*

*on contract

House Keeping
Anitha
Gangaraju
Gowramma
Muniswamy
Penchilaiah
Venkatesh.G
Venkatesh
Vijaya

Technical
Krishnappa
Kumarvel
Murthy G.

Dining Hall
Chandraiah D.
Hanumanthe Gowda
Huligesh
Manjula
Rathnamma
Sunitha
Yanishaliyonara

Hostel/Guest House
Jayakaran
Krishnamurthy
R.Venkatesh
R. Yashodha

Security
Adaiah Achari M.
Devaraju
Ganesh Kumar
Jayaram B.
M. Mahesh
Muthuraj K.
C.B.Muthurayappa
Rajashekar N.
Ranganathan
Revanasiddappa
Sampath Kumar
Shrirangaram M.
Shivanandappa
Vijaygopalan M.

Gardening
Andanappa R.
Jayaramaiah
SuryaKanthi

ALUMNI

Name (Supervisor)	Year	Currently at	Email
S. Anitha Nagamani (C.V. Yelamaggad)	2003	Portland, USA	sanithanagamani@gmail.com
K.L. Sandhya (S. Krishna Prasad)	2005	M.S.Ramaiah Institute of Technology, Bengaluru	klsandhya@gmail.com
Manoj Mathews (C.V. Yelamaggad)	2006	St. Joseph's College, Calicut	mathewsmanoj@gmail.com
I. Shashikala (C.V. Yelamaggad)	2007	Momentive Performance Materials India Pvt Ltd, Bengaluru	swamyshashi@gmail.com
Chethan V. Lobo (S. Krishna Prasad)	2007	Quantum Design India Pvt Ltd, Mumbai	chethanvishal@gmail.com
Gurumurthy Hegde (S. Krishna Prasad)	2007	R&D Centre, BMS, Bengaluru	murthyhegde@gmail.com
A. S. Achalkumar (C.V. Yelamaggad)	2008	IIT, Guwahati	achalkumar@iitg.ernet.in
G. Shanker (C.V. Yelamaggad)	2009	Bangalore University, Bengaluru	maanshanker@gmail.com
Pramoda Kumar (K.S. Krishnamurthy)	2010	Weizmann Institute, Israel	pramodkumarai@gmail.com
V. Jayalakshmi (S. Krishna Prasad)	2010	National Institute of Technology, Warangal	vlakshmij@gmail.com
Sridevi Chakravarthy (S. Krishna Prasad)	2012	USA	sridevischakravarthy@gmail.com
Pramod Tadapatri (K.S. Krishnamurthy)	2013	Raman Research Institute, Bengaluru	itsmepramod@gmail.com
Prasad N. Bapat (D. S. Shankar Rao)	2014	Sahyadri Science College, Shimoga.	prasadbapat.n@gmail.com
Rashmi Prabhu (C.V. Yelamaggad)	2015	IISER, Pune	rushmeprabhu@gmail.com
R Bhargavi (Geetha G. Nair)	2015	Bengaluru	bhargavi.r.r@gmail.com
Nagaveni N.G. (Veena Prasad)	2015	Govt. 1st Grade College, Harihara	ngnagu@gmail.com
Vijay Kumar M. (S. Krishna Prasad)	2015	Department of Physics, University of Gothenburg	mvkumar198525@gmail.com
Rajalakshmi R. (S. Angappane)	2016	Bengaluru	rajireng@gmail.com
H. N. Gayathri (K. A. Suresh)	2015*	Singatagere, Kadur Thaluk, Karnataka- 577 138	gayi3.murthy@gmail.com
Shilpa Harish T. (P. Viswanath)	2015*	Guest Faculty, Dept. of Physics, Bangalore University, Bengaluru	shilpa.svaraaga@gmail.com
P. Lakshmi Madhuri (S. Krishna Prasad)	2015*	Ben Gurion University, Israel	lakshmimadhuri.17@gmail.com
Nagaiah Kambhala (S. Angappane)	2015*	Research Associate, IIT Madras	nagaiahphy@gmail.com

*(thesis submitted)

PUBLICATIONS 2015-16

1. Ambient stable tetragonal and orthorhombic phases in penta-twinned bipyramidal Au microcrystals, G. Mettela, M. Bhogra, U. V. Waghmare and G. U. Kulkarni, J. Am. Chem. Soc, 137, 3024 - 3030 (2015). Impact Factor: 13.038

2. Highly decoupled graphene multilayers: Turbostraticity at its best, U. Mogera, R. Dhanya, R. Pujar, C. Narayana and G. U. Kulkarni, J. Phys. Chem. Lett., 6, 4437 - 4443 (2015). Impact Factor: 8.539

3. Columnar self-assembly of star-shaped luminescent oxadiazole and thiadiazole derivatives, S. K. Pathak, R. K. Gupta, S. Nath, D. S. Shankar Rao, S. Krishna Prasad, and A. S. Achalkumar, J. Mater. Chem.C 3, pp 2940-2952 (2015). Impact Factor: 5.066

4. Stable ferroelectric liquid crystals derived from salicylaldimine-core, B. N. Veerabhadraswamy, D. S. Shankar Rao, and C. V. Yelamaggad, J. Phys. Chem. B, 119, 4539 –4551 (2015). Impact Factor: 3.187

5. Optically active, three-ring calamitic liquid crystals: the occurrence of frustrated, helical and polar fluid mesophases, B. N. Veerabhadraswamy, D. S. Shankar Rao, S. Krishna Prasad and C. V. Yelamaggad, New J. Chem., 39, 2011 (2015). Impact Factor: 3.277

6. Investigation of dielectric relaxation, Jahn-Teller distortion, and magnetic ordering in Y substituted Pr1-xYxMnO3, Ruchika Yadav, Harikrishnan S.Nair, Amit Kumar, Shilpa Adiga, H.L.Bhat, S.M.Yusuf and Suja Elizabeth, Jour. of Appl. Phys., 117, 093903 (2015). Impact Factor: 2.101

7. Fabrication of oxidation-resistant metal wire network-based transparent electrodes by a spray-roll coating process, S. Kiruthika, R. Gupta, A. Anand, A. Kumar and G. U. Kulkarni, ACS Appl. Mater. Inter.,7, 27215 - 27222 (2015). Impact Factor: 7.145

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9. Rotational diffusion of a new large non polar dye molecule in alkanes, R. Goudar , R. Gupta, G. U. Kulkarni and S. R. Inamdar, J. Fluoresc., 1 - 9 (2015). Impact Factor: 1.601

10. Solution processed nanomanufacturing of sers substrates with random Ag nanoholes exhibiting uniformly high enhancement factor, R. Gupta, S. Siddhanta, G. Mettela, S. Chakraborty, C. Narayana and G. U. Kulkarni, RSC Adv., 5, 85019 - 85027 (2015). Impact Factor: 3.289

11. Viscoelastic nature of Au nanoparticle–PDMS nanocomposite gels, R. Gupta, H. K. Nagamanasa, R. Ganapathy and G. U. Kulkarni, Bull. Mater. Sci., 4, 817 - 823 (2015). Impact Factor: 0.895

12. Transparent metal network with low haze and high figure of merit applied to front and back electrodes in semitransparent ito-free polymer solar cells, C. Hunger, K. D. M. Rao, R. Gupta, C. R. Singh, G. U. Kulkarni and M. Thelakkat, Ener. Tech., 3, 638 - 645 (2015). Impact Factor: 2.557

13. Facet selective etching of Au microcrystallites, G. Mettela and G. U. Kulkarni, Nano Research, 8, 2925 - 2934 (2015) Impact Factor: 8.893

14. Towards low cost materials and methods for transparent electrodes, G. U. Kulkarni, S. Kiruthika, R. Gupta and K.D.M. Rao, Chem. Engg., 8, 60 - 68 (2015).Impact Factor: 3.571

15. Disposable heater arrays using printed silver patterns on polyethylene terephthalate for multipurpose applications, S. Walia, R. Gupta and G. U. Kulkarni, Ener. Tech., 3, 359 - 365 (2015). Impact Factor: 2.557

16. Worldwide outdoor round robin study of organic photovoltaic devices and modules, Madsen, M, Gevorgyan, S, Gupta, Ritu, Shanmugam, Kiruthika, Kulkarni, Giridhar U., Krebs, Frederik C and et. al., Sol Energ Mat Sol C, 130, 281 - 290 (2015). Impact Factor: 5.89

17. Transient, polarity-dependent dielectric response in a twisted nematic liquid crystal under very low frequency excitation, K. S. Krishnamurthy, Phys. Rev. E 92, 032504 -11 (2015). Impact Factor: 2.252

18. Electrical conductivity in Langmuir-Blodgett films of n-alkyl cyanobiphenyls using current sensing atomic force microscope, H. N. Gayathri and K.A. Suresh, J. App. Phys. 117, 245311-7 (2015) Impact Factor: 2.101

19. Fast photoluminescence switching in the nematic phase of calamitic-discotic composites, P. Lakshmi Madhuri, D.S. Shankar Rao, C. V. Yelamaggad and A.S. Achalkumar, and S. Krishna Prasad, Adv. Opt. Mater. 3, 1116 (2015). Impact Factor: 5.118

20. Enhancement of electrical conductivity of a liquid crystal-gold nanoparticle composite by a gel network of aerosil particles, B. Kamaliya, M. Vijay Kumar, C. V. Yelamaggad, and S. Krishna Prasad, Appl. Phys. Lett., 083110-5 (2015). Impact Factor: 2.99

21. Dielectric properties of anti-ferroelectric B2 phase of bent core liquid crystal, P.K. Mukherjee and S. Krishna Prasad, J. Mol. Liquids 212, 127 - 132 (2015). Impact Factor: 2.740

22. Self-assembly of luminescent n-annulated perylene tetraesters into fluid columnar phases, R. K. Gupta, B. Pradhan, D. S. Shankar Rao, S. Krishna Prasad and A. S. Achalkumar, Soft Matter 11, 3629 - 3636 (2015) Impact Factor: 3.798

23. Anchoring transition driven by short range ordering in calamitic-discotic composites, Srividhya Parthasarathi, D.S. Shankar Rao, Hemant Kumar Singh, B. Singh, and S. Krishna Prasad, Thermochim. Acta 616, 61 - 68 (2015). Impact Factor: 1.938

24. Tuning the thermotropic properties of liquid crystalline p-substituted aroylhydrazones, H. K. Singh, S. K. Singh, R. Nandi, M. K. Singh, Vijay Kumar, R. K. Singh, S. Krishna Prasad, D.S. Shankar Rao and B. Singh, RSC Adv., 5, 44274 - 44281 (2015) Impact Factor: 3.289

25. Synthesis and aggregation behaviour of luminescent mesomorphic zinc(II) complexes with 'salen' type asymmetric Schiff base ligand, S. Chakraborty, C. R. Bhattacharjee, P. Mondal, S. Krishna Prasad, and D. S. Shankar Rao, Dalton Trans. 44, 7477 - 88 (2015) Impact Factor: 4.177

26. Effect of regioisomerism on the self-assembly and photophysical behavior of 1,3,4-thiadiazole-based polycatenar, S. K. Pathak, S. Nath, R. K. Gupta, D. S. Shankar Rao, S. Krishna Prasad and A. S. Achalkumar, J. Mater. Chem. C, 3, 8166 - 8182 (2015). Impact Factor: 5.066

27. Hockey stick-shaped azo compounds: effect of linkage groups and their direction of linking on mesomorphic properties, M. Monika, Veena Prasad and N.G. Nagaveni, Liq. Cryst., 42, 1490 - 1505 (2015). Impact Factor: 2.244

28. Studies of intermolecular hydrogen bonded complex of butyloxy benzoic acid and dipyridyl ethylene, A. Sambyal, G. Kour, S. Sharma, R. K. Bamezai, S. Anthal, V. K. Gupta, R. Kant and C. V. Yelamaggad. Mol. Cryst . Liq. Cryst., 608, 135 - 145 (2015). Impact Factor: 0.532

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