2021Annual Meeting of TLCS

《CV and Invited talk abstract》

簡　介

Name: Mon-Juan Lee

Current position:

Chair, Department of Medical Science Industries, Chang Jung Christian University

Professor, Department of Bioscience Technology, Chang Jung Christian University

Professional History:

Apr 2020–Sep 2021 | Guest Editor, Biosensors (ISSN 2079-6374) special issue "Electrical and Electro-Optical Biosensors"

Feb 2018–Jul 2018 | Visiting Scholar, Lombardi Comprehensive Cancer Center, Georgetown University, Washington DC, USA

2014–2019 | Associate Professor, Department of Bioscience Technology, Chang Jung Christian University

2008–2014 | Assistant Professor, Department of Bioscience Technology, Chang Jung Christian University

Topic :

Biosensing Applications of Liquid Crystals: Interfacing with Biological Analytes

Abstract:

Biosensors and sensing technologies are the cornerstones of medical laboratory science and the nexus of precision medicine. In this presentation, the state-of-the-art technologies of liquid crystal (LC)-based biosensing, including our contribution to this field in collaboration with National Yang Ming Chiao Tung University, are introduced. LCs are being explored as the sensing media for the detection of biological analytes such as small-molecule metabolites, peptides, proteins, immunocomplexes, DNA, as well as whole-cell entities such as cells, bacteria and viruses. A background introduction to the working principles or gold standards of common clinical and biochemical assays is given in the hope of inspiring more brilliant minds in the liquid crystal society to participate in the diverse and multidisciplinary biomedical application of LCs.

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簡　介

Name: Yo Shimizu (洋　清水)

Current position: Specially appointed professor, Division of Materials Science, Graduate School of Science and Technology, Nara Institute of Science and Technology (NAIST)

Professional History:

1986 PhD in chemistry, Osaka University

1986-1990 Researcher, Sumitomo Electric Industries, Ltd.

1990-2000 Researcher, Osaka National Research Institute (ONRI)

2000-2017 Research group leader, National Institute of Advanced Industrial Science and Technology (AIST) at Kansai Center

2017-present: SA-professor, Nara Institute of Science and Technology (NAIST) and Collaborative manager of MEXT Nanotechnology Platform project at NAIST

Topic :

Mesomorphic phase transitions with the change of anisotropic shape in mesogenic molecules

Abstract: Anisotropic shape of molecule is an important factor for the formation of mesophase and its long-range order. In historical point of view, two categories of molecular anisotropy in shape, rod and disc (we say “calamitic” and “discotic” LCs, respectively), have been considered and the anisotropy is an origin of anisotropic intermolecular interactions which makes mobile molecules ordered. It was found that a triphenylene derivatives possessing six tetradecyloxyazobenzene units attached at the periphery which are linked by propylene-ester group exhibits calamitic and discotic bimesomorphism as the first example for a single component system where a SmA to/from Colr phase transition was observed in a enantiotropic manner. This phase transition should be accompanied with change of molecular conformation to give transformation of molecular anisotropy between rod and disc. Recent studies by

synchrotron radiation X-ray diffraction experiments reveal that this anisotropic transformation is caused by conformation change of molecules which is derived from change of balance in intermolecular interaction between inter-rod (azobenzene units) and inter-disc (triphenylene units) ones on temperature. The mesomorphic phase transition behavior of the alkyl homologues and the influence of chemical structure of the linkage groups on the mesomorphism are also shown to discuss how could we control the mesomorphism by way of the conformation change and it would be able to open the door toward new functional materials based on LCs.

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簡　介

Name: Yan-Song Zhang
Current position: Postdoctoral researcher

Professional History:
2013-2015: Master in Department of Chemical Engineering at National Cheng Kung University
2015-2018: PhD in Department of Chemical Engineering at National Cheng Kung University
2018-present: Post-Doc at Department of Photonics, at National Cheng Kung University (Prof. Chia-Rong Lee Lab)

Topic : Liquid Crystalline Polymers and Their Applications

Abstract:

Liquid crystalline polymers are anisotropic smart materials present a feature that the macroscopic shape is intensively correlated with molecular orientational order and vice versa. This unique feature stems from the combination a loosely cross-linked network of liquid crystalline moieties with controlled molecular alignment and rubber elasticity, enables us to actuate the LCP (include LC elastomers and LC networks) under various types of external stimuli such as temperature variation, electric fields, and light irradiation that affect the molecular orientational order. To date, the deformations and surface transformations in LCPs with several types of orientational order have been extensively studied. However, photo-induced reconfigurations cholesteric and blue phase LCPs (CLCPs and BPLCPs) have received much attention due to the salient features as a photonic film. Not only the cholesteric liquid crystals governed by the periodic pitch of the helical configuration exhibit selective Bragg reflection for incident light with a specific wavelength, but also the stimuli light allow remote and wireless activation, spatial and temporal control, and regulation via wavelength, intensity, and polarization. The multiple micro-morphology, physical and optoelectronic properties of liquid crystal composite self-assembled films, microspheres and elastomers were investigated by polarized microscope, scanning electron microscope, dynamic mechanical analysis and other instruments.

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簡　介

Name: Jiun-You Lin

Current position: Professor at National Changhua University of Education, Taiwan.

Professional History :

2000: Master at Institute of Electro-Optical Engineering of National Chiao Tung University

2000-2005: PhD student and Post-Doc at National Chiao Tung University

2005-2009: Asst. Professor at National Changhua University of Education

2009-2021: Assoc. Professor at National Changhua University of Education

2021-now: Professor at National Changhua University of Education. Research on optical metrology and optical sensing techniques.

Topic : Principles and Applications of Laser Heterodyne Interferometry

Abstract:

Laser heterodyne interferometry was developed in 1960s. This interferometric technique is still widely used in precision measurements, due to its superiority such as high resolution and high accuracy, and real-time measurements. This presentation will introduce the principles of the interferometric technique, including the generation of a heterodyne light source, the optical configurations, the phase analysis system, and the phase error sources. Then the presentation will introduce the various applications of the laser heterodyne interferometric technique in precision positioning, biochemical testing and material parameter measurements, and its possible future applications.

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簡　介

Name: Yang Kun-Lin
Current position: Associate Professor

Professional History:
Ph.D Georgia Tech
MS National Taiwan University
BS National Taiwan University

楊昆霖教授 1994 年畢業於台灣大學化學工程系，並且在 1996 年取得碩士學位. 之後於 1998 年赴美國佐治亞理工學院深造，於 2002 取後博士學位. 就學期間，他以優異的成績獲得美國分子設計獎學金，並以電雙層的研究得到美國化學學會最佳博士論文獎. 同年，他前往威辛康辛大學麥迪遜校區從事博士後研究，專攻液晶在化學及生物傳感器方面的應用. 2005 年他取得新加坡大學的助理教授一職，並成立液晶及生物分子實驗室，繼續他在液晶方面的研究，並且開啟一個微流體傳感器 2012 榮升副教授並取得終生教職. 在新加坡的這段時間，他在液晶傳感器的研究取得重大突破，並且發表在 SCI 著名期刊包括 Advanced Materials, Advanced Functional Materials, Langmuir 及 Biosensors and Bioelectronics. 同時，他也獲得許多國家級科研基金，專利和研究獎勵，包括 Defence Innovation Award, A*STAR Research Award, TechConnect Award. 此外，他還是一位受學生歡迎的好老師，在各項教學評鑑中名列前茅，也是教學獎的常客，最近連續三年他都獲得新加坡大學的最佳教學獎，並進入教學獎名人榜.

Topic : Polymer Network-Liquid Crystal (PNLC) as Functional Coatings for Sensing Applications

Abstract:
Although chiral nematic liquid crystal (ChLC) has been used as functional coatings for various temperature and chemical sensing applications, the color of ChLC is angle-dependent and it does not have a wide sensing range. In this presentation, we report a new type of functional coating material made from polymer-network nematic liquid crystal (PNLC). The new material has a LC polymeric scaffold supporting low-molecular-weight liquid crystal (LMWLC) such as 4'-pentyl-4-biphenylcarbonitrile (5CB). PNLC can be prepared by mixing reactive mesogen(s), 5CB and a photo-initiator followed by controlled UV light exposure to cross-link the reactive mesogen(s). Interplay between the mesogenic units in the LC polymer

and 5CB give rise to many interesting sensing properties (e.g. dual transition) and new sensing capabilities (e.g. oxygen sensing). The new material also possesses high stability and is more suitable for functional coatings on solid surfaces.

Firstly, the PNLC can be applied as temperature sensing materials. For pure LMWLC 5CB, the color changes abruptly when it is heated beyond a clearing point. However, PNLC with straight polymer threads exhibits a full color spectrum over a wide temperature range. The color changes from blue to purple and then to orange when the temperature is increased from 50 °C to 140 °C. A specific temperature can also be obtained by using pattern recognition with PNLC having different compositions. Besides the color change, other responses could also be obtained by changing the polymer morphologies. For PNLC with remaining free radicals after cross-linking, a second-stage polymerization occurs when the sample is heated beyond a critical temperature. Meanwhile, the appearance of the sample changes irreversibly from transparent to cloudy. This phenomenon is useful for the detection of an over-heating event beyond a particular temperature. For PNLC with sphere-like polymer network, the appearance of the sample undergoes a dual transition from transparent to cloudy and then to transparent with increasing temperature. This principle can be used to design a temperature-responsive smart window which appears transparent only in a defined temperature range.

Secondly, the PNLC is used as a chemical sensor for detecting toluene vapor and oxygen gas. For PNLC with straight polymer threads, its interference color changes when it is exposed to different toluene vapor concentrations from 9,300 ppm to 2,800 ppm. For PNLC with sphere-like polymer network, the appearance changes from transparent to cloudy at 4,000 ppm, and then to transparent with a further increase in the toluene vapor concentration to 10,000 ppm. Through controlled UV exposure, it is possible to leave some free radicals intentionally inside the PNLC during sample preparation. These free radicals are highly reactive and they offer additional sensing capabilities for the detection of gases. For example, when oxygen diffuses through the PNLC, it reacts with the free radicals and deactivates them. Hence, when the sample is heated, the second-stage polymerization stage is hindered and the sample remains transparent. Therefore, by analyzing the appearance of PNLC, a histogram of oxygen exposure could be revealed as a color map.

In conclusion, functional coatings based on PNLC are developed for temperature and chemical sensing. Unlike conventional sensors based on pure LMWLC, the responses of PNLC to external stimuli are shown to be more colorful and versatile. Depending on different polymer morphologies, the responses are manifest as changes in colors or transparency, and these changes can be either reversible or irreversible. Thanks to their polymeric properties, PNLC are coated directly on a solid surface as a real-time, standalone, power-free sensor for temperature and gases. We believe that the PNLC-based sensors will be exploited for many other sensing applications in the future.

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簡　介

Name: Yu-Chieh Cheng
Current position: Associate Professor at National Taipei University of Technology, Taiwan

Professional History:

2010-2011
M.S. in National Central University (NCU)
2011-2015
PhD in Europhotonics EM Doctorate program at Universitat Politecnica de Catalunya and European Laboratory for Non-Linear Spectroscopy
2015-2016
Product development Engineer at Intel Research & Development Ireland Limited
2016-Now
Professor at Department of Electro-Optical Engineering, National Taipei University of Technology (NTUT)

Research on liquid Crystals Elastomers, Photonics, Bio-inspired, Micro-robots, Light/matter interaction, soft materials, Metasurface, Random laser, Flat focusing devices.

Topic : Light-driven liquid crystalline networks: from molecular dynamics, actuator modeling to soft robotic applications

Abstract:
The talk will focus on light-driven microrobot team and swarm. An intelligent and bio-inspired light-driven micro-walker based on light-sensitive deformation of liquid crystal elastomers (LCEs) will be introduced. LCEs, photoresponsive polymers, have been demonstrated to be valid candidates for an "intrinsic" and intelligent material cleverness. The proposed intelligent light-driven walker, equipped with tunable lasing and flat

focusing devices, fundamentally different from other conventional actuating methods that rely on external forces, has self-guiding behavior to decide where/when to carry out a specific task. The proposed research is focused on studying and discovering light-matter interaction phenomena in the microscopic scale.

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簡　介

Name: Shie-Chang Jeng
Current position:
Associate Professor,
Institute of Imaging and Biomedical Photonics,
National Yang Ming Chiao Tung University

Professional History:

Shie-Chang Jeng is an associate professor at the College of Photonics, National Yang Ming Chiao Tung University. He received his Ph.D. degree in physics from the Colorado State University in 2004. He joined ERSO/ITRI for developing the next generation flexible displays after graduation. In 2008 he moved to the National Kaohsiung University of Applied Sciences as an assistant professor. Since 2009 he has been at the National Chiao Tung University. His research focuses on liquid crystal devices, nanomaterials applications, and optoelectronic tweezers.

Topic : Novel Liquid Crystal Alignments - Materials, Processes, and Inspections

Abstract:

The control of liquid crystal (LC) molecules on solid films is an important topic for academic researches and photonic applications. The buffed organic polyimide (PI) films adopted in current LC industries have several drawbacks. Operation of LC devices in severe conditions, such as high intensity of light and high temperature, may cause degradation of PI films. Many chemicals are required for synthesizing PI solution, such as diamines, organic polar solvents (e.g., N-methyl-2-pyrrolidone), catalysts, and coupling agents. The final prepared PI films cannot be recycled, and they are not biodegradable as well, which causes environmental problems. Electrostatic problem and dust particles are also found in the rubbing process. Novel LC alignments, including inorganic ZnO films, biodegradable silk films, non-contact atmospheric-pressure plasma alignment process, and Tamm plasmon for inspecting the anisotropy of alignment films, will be presented in this talk to address these issues.

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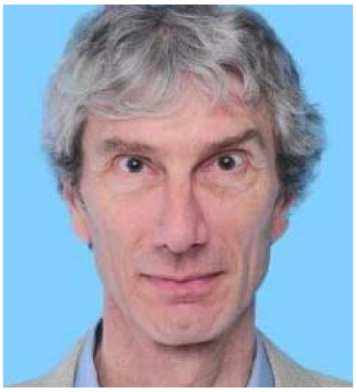

簡　介

Name: Kristiaan Neyts
Current position: Full Professor at Ghent University
Head of the LCP research group at UGent, Belgium

Professional History:
1987: Master in Physics Engineering at UGent
1987-1988: Researcher at Uni Stuttgart, Germany
1988-2000: PhD student and Post-Doc at UGent
1997-1998: Post-Doc at UC Berkeley, USA
2000-now: Professor at Ghent University

Topic : Photoalignment for defining 3D liquid crystal structures

Abstract:
Photoalignment with linearly polarized blue light incident on a photo-sensitive layer, can create complex alignment patterns on the surface of a substrate. When the substrate is covered with a layer of nematic or chiral nematic liquid crystal (LC), interesting 3D patterns can occur in the bulk of the layer. Periodic alignment structures have been used to create transmissive diffraction gratings with nematic LC [1] and reflective diffraction gratings with chiral nematic LC [2]. The intrinsic short pitch of chiral LC allows to make gratings with a submicrometer period and a diffraction larger than 45° while maintaining an efficiency above 90% for circularly polarized light. Well-designed ring-shaped planar alignment patterns can create regions in the LC with perpendicular director orientation [3,4]. If the surface pattern contains defects, where the alignment is not defined, disclination lines are created in the bulk of the liquid crystal that connect the defects in pairs [5].

[1] B. Gao, J. Beeckman, K. Neyts, Crystals **2021**, 11 (2), 220

[2] I. Nys, M. Stebryte, Y. Ussembayev, J. Beeckman, K. Neyts, *Adv. Opt. Mater.* **2019**, *7,* 1901364

[3] B. Berteloot, I. Nys, G. Poy, J. Beeckman, K. Neyts, *Soft Matter* **2020**, *16*(21), 4999-5008

[4] B. Berteloot, I. Nys, X. Xue, J. Beeckman, K. Neyts, *Journal Mol. Liq.* **2021**, *337*, 116238

[5] I. Nys, B. Berteloot, J. Beeckman, K. Neyts, *Adv. Opt. Mater.* **2021**, *accepted*