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[Department Spotlight] Professor Chih-Hsin Chen's Research Team Publishes Two Consecutive Papers in Leading International Journals

Professor Chih-Hsin Chen, Chair of the Department of Chemistry, co-published two papers with his students. The first, co-authored with postdoctoral researcher Rajib Nandi and senior student Yung-Jung Chuang, is titled "Liquid crystal sensor for Cr (III)-citrate detection via interfacial coagulation", and was published in Analytica Chimica Acta, a top-tier Q1 journal with an impact factor of 5.7. The second paper, authored by master's student Wen-Hao Zhang under Professor Chen's supervision, is titled "Cyano-Substituted Bis((benzothiophen-2-yl)pyridine) (acetylacetonate) Iridium Complexes for Efficient and Stable Deep Red Organic Light-Emitting Diodes Emitting at 673 nm", and appeared in the Q1 journal Dyes and Pigments, which has an impact factor of 4.1.

Dr. Rajib Nandi and Yung-Jung Chuang developed the sensor using a unique phosphonium ion material (THPB) blended with liquid crystals. When detecting toxic Cr (III)-citrate, the sensor shifts from a dark to a bright optical state, allowing for naked-eye real-time detection. Professor Chen noted that this technique offers high selectivity and a sensitivity of 5 μM, all without the need for expensive instruments, making it ideal for on-site water quality monitoring and providing a simple, fast, and effective tool for detecting heavy metal pollution in the environment.

Yung-Jung Chuang, who has been admitted to the Institute of Analytical and Environmental Sciences at National Tsing Hua University, expressed her desire to integrate this method with other metal ion detection technologies developed by her seniors. She hopes to co-design a multifunctional liquid crystal sensor capable of detecting multiple analytes using different probe molecules. "With the right combinations, we may be able to detect various targets using a single device," she said.

Wen-Hao Zhang, who has now graduated, explained that the newly developed deep red organic light-emitting material features excellent luminescence efficiency and stability. The fabricated OLED device achieved an external quantum efficiency (EQE) of 10.2%. It demonstrated a lifetime of 190 hours at 200 cd/m^2 brightness, making it one of the best-performing deep red OLEDs reported to date. “These deep red materials are well-suited for high-end displays and near-infrared sensing, and also show promise in biomedical applications like photodynamic therapy,” he added. The materials are also simple to synthesize, indicating potential for broader applications in agricultural lighting and display technologies, showcasing Taiwan’s innovative strength in developing organic optoelectronic materials.

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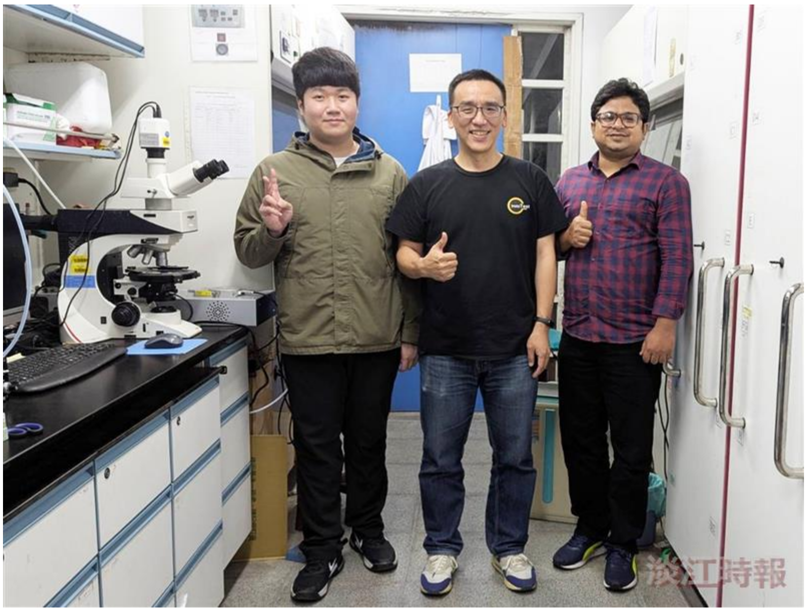
Chair of the Department of Chemistry, Professor Chih-Hsin Chen (left), along with postdoctoral researcher Rajib Nandi and senior undergraduate student Yung-Jung Chuang (right), published a study, “Liquid crystal sensor for Cr(III)-citrate detection via interfacial coagulation” in the international journal Analytica Chimica Acta, which has an impact factor of 5.7.

Professor Chih-Hsin Chen, Chair of the Department of Chemistry, along with postdoctoral researcher Rajib Nandi and senior undergraduate student Yung-Jung Chuang, published a study, “Liquid crystal sensor for Cr (III)-citrate detection via interfacial coagulation” in the international journal Analytica Chimica



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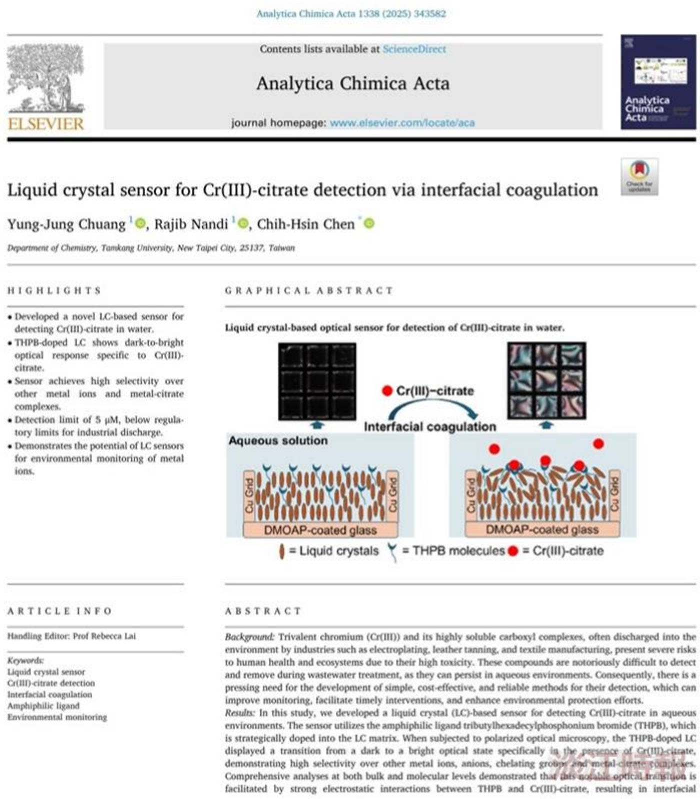

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Liquid crystal sensor for Cr(III)-citrate detection via interfacial coagulation

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HIGHLIGHTS

- Developed a novel LC-based sensor for detecting Cr(III)-citrate in water.
- THPB-doped LC shows dark-to-bright optical response specific to Cr(III)-citrate.
- Sensor achieves high selectivity over other metal ions and metal-citrate complexes.
- Detection limit of 5 μM, below regulatory limits for industrial discharge.
- Demonstrates the potential of LC sensors for environmental monitoring of metal ions.

GRAPHICAL ABSTRACT

Liquid crystal-based optical sensor for detection of Cr(III)-citrate in water.

ARTICLE INFO

Handling Editor: Prof Rebecca Lai

Keywords:
Liquid crystal sensor
Cr(III)-citrate detection
Interfacial coagulation
Amphiphilic ligand
Environmental monitoring

ABSTRACT

Background: Trivalent chromium (Cr(III)) and its highly soluble carboxyl complexes, often discharged into the environment by industries such as electroplating, leather tanning, and textile manufacturing, present severe risks to human health and ecosystems due to their high toxicity. These compounds are notoriously difficult to detect and remove during wastewater treatment, as they can persist in aqueous environments. Consequently, there is a pressing need for the development of simple, cost-effective, and reliable methods for their detection, which can improve monitoring, facilitate timely interventions, and enhance environmental protection efforts.

Results: In this study, we developed a liquid crystal (LC)-based sensor for detecting Cr(III)-citrate in aqueous environments. The sensor utilizes the amphiphilic ligand tributylhexadecylphosphonium bromide (THPB), which is strategically doped into the LC matrix. When subjected to polarized optical microscopy, the THPB-doped LC displayed a transition from a dark to a bright optical state specifically in the presence of Cr(III)-citrate, demonstrating high selectivity over other metal ions, anions, chelating groups and metal-citrate complexes. Comprehensive analyses at both bulk and molecular levels demonstrated that this notable optical transition is facilitated by strong electrostatic interactions between THPB and Cr(III)-citrate, resulting in interfacial

Professor Chih-Hsin Chen, Chair of the Department of Chemistry, supervised the publication of a paper in an international journal with senior chemistry student Yung-Jung Chuang as the first author and postdoctoral researcher Rajib Nandi as the second author.

Professor Chih-Hsin Chen supervised master' s student Wen-Hao Zhang in publishing a paper in the international journal Dyes and Pigments, which has an impact factor of 4.1 and is classified as a Q1 journal in its scientific research field.

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Cyano-substituted Bis((benzothiophen-2-yl)pyridine) (acetylacetonate) iridium complexes for efficient and stable deep red organic light-emitting diodes emitting at 673 nm

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ARTICLE INFO

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Deep-red OLEDs
Iridium complexes
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ABSTRACT

This study explores the development of cyano-substituted bis((benzothiophen-2-yl)pyridine) (acetylacetonate) iridium complexes, specifically $Ir(btpCN)_2(acac)$, for use in efficient and stable deep red organic light-emitting diodes (OLEDs) emitting at 673 nm. The new emitter, $Ir(btpCN)_2(acac)$, was designed to achieve red-shifted emission through strategic cyano substitution at the meta-position of pyridine moiety of btp ligand, leveraging the favorable overlap between its emission spectrum and the absorption spectrum of the exciplex host composed of BCzPh and CN-T2T. The OLED devices employing $Ir(btpCN)_2(acac)$ as the emitter exhibited a peak external quantum efficiency (EQE) of 10.2 % and an emission wavelength of 673 nm. Significantly, these devices demonstrated superior operational stability, with a lifetime (LT_{50}) of 190.8 h at an initial luminance of 200 cd m^{-2}, which is among the highest reported for deep-red OLEDs in the literature. This remarkable stability is achieved without compromising the device performance, making $Ir(btpCN)_2(acac)$ a highly promising candidate for commercial applications. In addition, the straightforward synthesis process of $Ir(btpCN)_2(acac)$ further enhances its potential for widespread use. Overall, our findings highlight the potential of cyano-substituted Ir complexes for creating efficient, stable, and commercially viable deep-red OLEDs. The balanced performance of $Ir(btpCN)_2(acac)$ in terms of efficiency, stability, and ease of synthesis marks a significant advancement in the development of OLED technology suitable for phototherapy and other applications requiring reliable deep-red light sources.