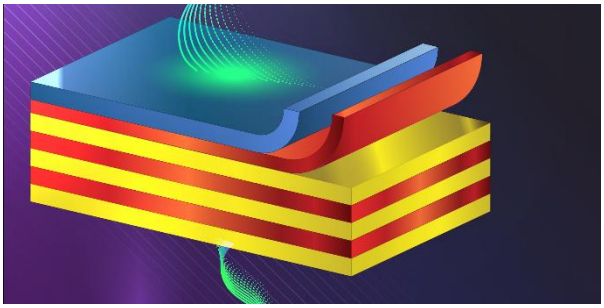
Dr. C. S. Suchand Sangeeth

Angle-tunable polymeric photonic diode with 1D-photonic crystal for enhanced light control

Integrated optical circuits depend on optical diodes for passive nonreciprocal light transmission. The realization of optical diode action remains a significant challenge in nanophotonics, with conventional approaches often relying on non-compact and expensive magneto and electro-optic isolators. We have made an angle-tunable polymeric photonic diode with enhanced light control by integrating it with a 1D photonic crystal. The diode's non-reciprocity can be controlled by changing the incident light angle. In contrast to earlier diodes employing this principle, this diode architecture offers a simplified fabrication process, exhibits a compact footprint, and eliminates the need for a liquid phase. Our structure exhibits a nonreciprocity factor of ~12.5 dB, achieved through a facile and cost-effective fabrication method. This promising combination makes this system a potential candidate for developing compact photonic integrated devices. The work is recently published in Journal of Materials Chemistry C. The work was carried out under the guidance of Dr. C. S. Suchand Sangeeth and Prof. Chandrasekharan K.



Dr. Aswathi G.

Electrochemical water splitting is a sustainable method for green hydrogen production, but requires highly active and low-cost alternatives to the traditional expensive noble metal-based catalysts such as Platinum. Hitherto, the search for such alternative electrocatalysts with reliable stability has not been fulfilled. Also, many state-of-the-art synthesis methods are suitable for laboratory conditions, laborious and require expensive synthesis facilities. Here, we have developed a facile low-temperature solvothermal synthesis method for the direct growth of cobalt sulfide-based nanospheres (Co_xS_y) on carbon cloth (CC) as binder-free and self-standing working electrodes for direct applications as efficient HER catalysts. The as-synthesized electrocatalyst materials (Co_xS_y/CC) showed good electrocatalytic performance with reliable stability for HER in both acidic (0.5 M H_2SO_4) and alkaline media (1 M KOH). The synthesis method followed in this work can be effectively extended to other metal sulfides as well to obtain more efficient HER catalyst materials for future needs.

ACS APPLIED NANO MATERIALS

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Low-Temperature Solvothermal Growth of Co_xS_y Nanospheres on Conducting Substrates as Efficient Electrodes for Hydrogen Evolution Reaction

Nabeel Nafeesa Abu, Amal Benny, and Aswathi Ganesan*

Cite This: *ACS Appl. Nano Mater.* 2023, 6, 17100–17110 Read Online

Prof. Ravi Varma

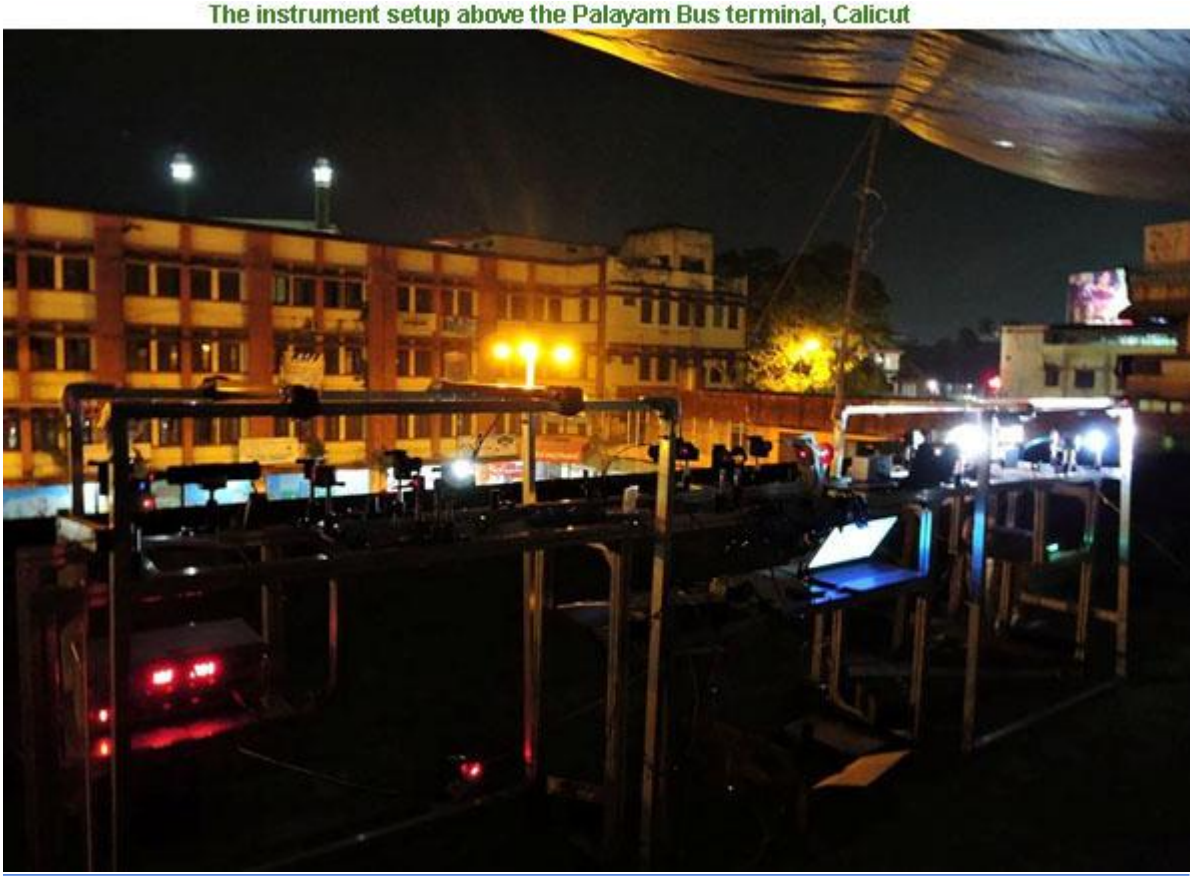
Quantitative measurement of atmospheric trace gases with high accuracy.

Researchers of Applied Optics and Instrumentation laboratory (AOI), Department of Physics, NIT- Calicut developed an instrument that can measure the tropospheric trace gases, especially Nitrate radical (NO3 radical) with high accuracy. The instrument was designed and developed in AOI lab and was deployed in the heart of Calicut city at Palayam Bus terminal, with the help of Calicut Corporation. The experiment's success was marked by pin pointing the presence of NO3 radical in Calicut city, which is formed in the atmosphere by the chemical reaction of tropospheric Nitrogen dioxide (NO2) and O3 (Ozone). The key source of NO2 in the city is from vehicle exhaust and the presence of NO3 indicates that the pollution from the vehicle exhaust is high in the city. By deploying the instrument in the urban area, the researchers proved that the technique used behind the instrument could be used efficiently for the accurate monitoring of other trace gas species too, that have far reaching impact on both climate and human health. The experiment was carried out under the guidance of Prof.M.K.RaviVarma, Department of Physics, NIT Calicut. Arun R., Suhail Kuttoth, Sherya Joshy, Shebin John, Aishwarya S. and Anoop P. were the researchers who worked behind the development and deployment of this instrument.

The specific field measurement and the results appeared in the regional newspaper Mathurbhumi, Dt. 21-12-2018. Please refer to the following link for online version of the news. https://www.mathrubhumi.com/technology/news/new-spectroscope-system-to-measure-pollution--1.3412111

People behind the development of the instrument, from left: SuhailKuttoth, Arun R., Prof.M.K.RaviVarima

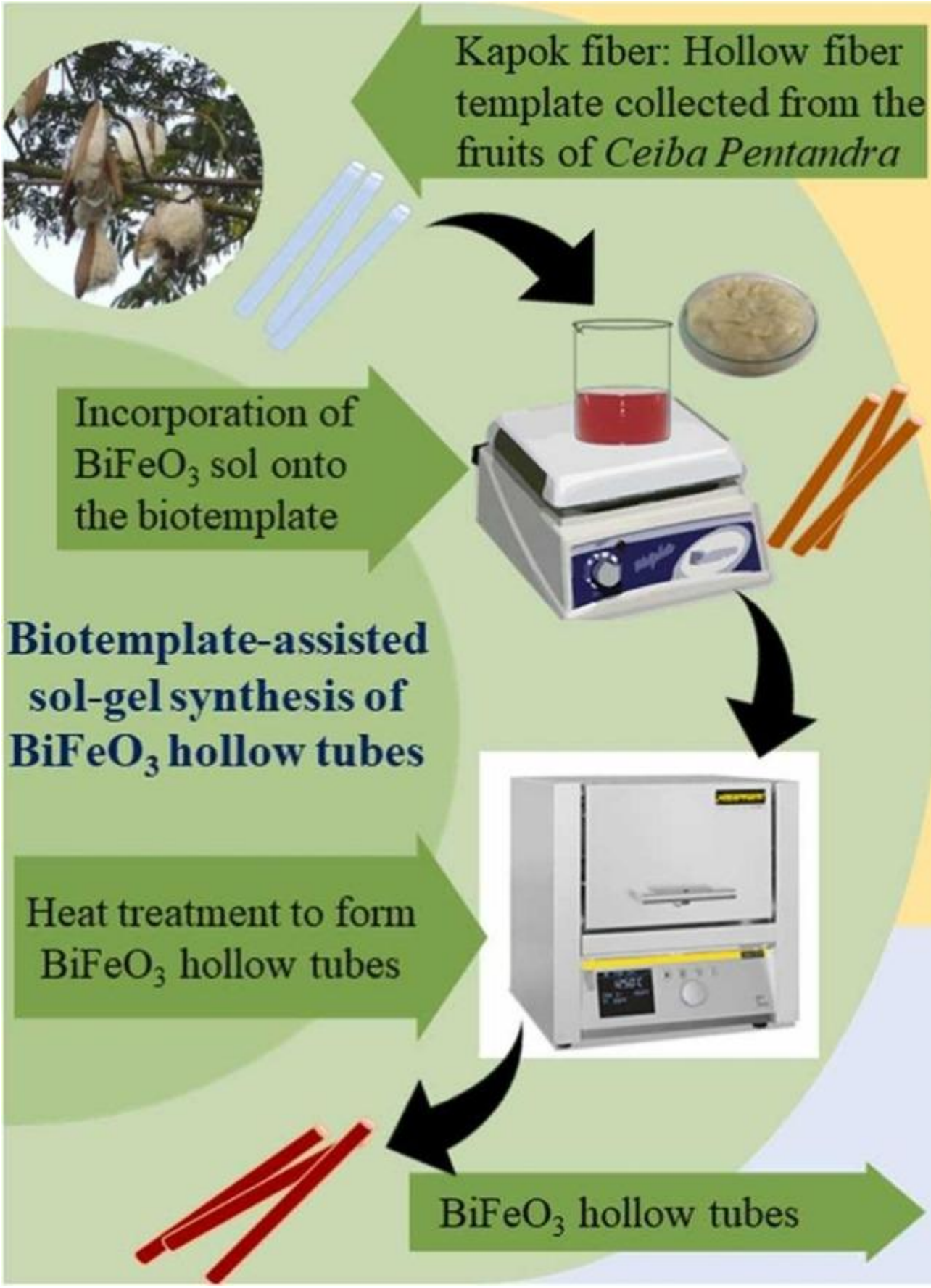
The instrument setup above the Palayam Bus terminal, Calicut



Dr. Maneesh Chandran

Template assisted sol-gel synthesis of $BiFeO_3$ hollow tubes: Introducing kapok fiber as a bio-template

Bismuth ferrite ($BiFeO_3$) is a perovskite material well known for its multifunctional properties and related applications in photocatalysis and sensing. In this work, we introduced a facile method for the synthesis of $BiFeO_3$ hollow tubes using the sol-gel method, where kapok fiber collected from *Ceiba pentandra* is used as a biotemplate for the first time. The structural analysis was carried out using XRD and Raman analysis, whereas the formation of hollow tube morphology was confirmed with the help of FESEM analysis. The complete decomposition of the kapok fiber template during the annealing process was confirmed with the help of Fourier transform infrared spectroscopy. The XRD analysis indicated that monitoring both the annealing pathway and the final annealing temperature is pivotal in attaining the formation of phase pure $BiFeO_3$. The proposed method eliminates the requirement for additional procedures for extracting the synthesized hollow tubes from the parent template, in addition to providing a less expensive strategy for the synthesis of $BiFeO_3$ hollow tubes. The experiment was guided by Dr. Maneesh Chandran, Department of Physics, NIT Calicut. This was published in *Materials Today Communications*.


Kapok fiber: Hollow fiber template collected from the fruits of *Ceiba Pentandra*
Incorporation of $BiFeO_3$ sol onto the biotemplate
Biotemplate-assisted sol-gel synthesis of $BiFeO_3$ hollow tubes
Heat treatment to form $BiFeO_3$ hollow tubes
$BiFeO_3$ hollow tubes

Prof. Aji A. Anappara (Photonic Materials and Devices Laboratory)

Self-powered photodetectors on paper substrates for UV-vis-NIR detection

Self-powered photodetectors are devices that convert radiant energy to electrical response (voltage or current) without the need for an external power source or battery for their operation. These devices have a wide range of applications across various fields such as environmental monitoring, smart lighting, wearable technology, Internet of Things (IoT) devices, security and surveillance, biomedical devices as well as transportation; owing to their unique traits of energy autonomous operation, dark-current suppression, wide-band sensitivity and ambient-temperature operation. Recently, in the Photonic Materials and Devices Laboratory (NITC), we have designed and fabricated flexible, paper-based photodetectors which can detect wavelengths covering UV-vis-NIR ranges of electromagnetic spectrum. These devices can operate at ambient conditions of temperature and humidity, without the requirement of external biasing. This work was guided by Prof. Aji A. Anappara, and was done as a part of the doctoral thesis of Ms. Varsha Sharma (P210011PH), and was granted multiple Indian patents (Patent No.: 532661, granted on 12/04/2024; Patent No.: 529570, granted on 21/03/2024; Patent No.: 551014, granted on 25/09/2024 and, Patent No.: 541052, granted on 06/06/2024).

Prof. Aji A. Anappara (Photonic Materials and Devices Laboratory)

Event-responsive, retinomorphic sensors for light-intensity detection

Event-driven optical sensors respond to changes in light intensity and can selectively sense specific events or stimuli, much like how human eyes process visual information. These are devices designed to mimic the functionality of biological retinas. By responding to specific events, with fast-response, making them ideal for real-time monitoring or remote operations, even without the requirement of a battery or external bias. In the Photonic Materials and Devices Laboratory (NITC), we have realized event-responsive retinomorphic sensors which can operate at room-temperature. The design was developed by Prof. Aji A. Anappara and was fabricated by Ms. Varsha Sharma (P210011PH) as a part of her Ph.D. research. The work was granted an Indian Patent No.: 541052 (granted on 06/06/2024). In NITC, we have developed zero-bias, retinomorphic photodetectors exclusively using all-edible materials as well; the architecture and working are published as an Indian Patent (Appl. No.: 202441029524, published on 19/04/2024).