INTRODUCING THE SPEAKER:

Professor Sadagopan Krishnan was born in Ambasamudram, Tirunelveli District, Tamil Nadu. He completed his studies until his M.Sc. in chemistry in Tamil Nadu. He then worked for a few months as a chemist at the Asian Paints India Ltd. In Hyderabad, followed by a short research fellow position at the Naval Materials Research Laboratory located in Ambernath, Thane District, Mumbai. He then was a Scientific Officer at the Tata Institute of Fundamental Research in Mumbai before heading to the United States to pursue his Ph.D. in Bioanalytical Chemistry at the University of Connecticut, Storrs, USA (Ph.D. Adviser: Prof. James Rusling). He then pursued postdoctoral research at Oxford University in the United Kingdom under the guidance of Prof. Fraser Armstrong. He has been a Professor of Chemistry at Oklahoma State University since 2012. Dr. Krishnan's current research focuses on the development of multi-probe/multiplex approaches for infectious diseases and their evolving variants, point-of-need sensors, electroanalytical meat science, and nano-biomaterials for addressing pharmaceutical, biocatalytic, and clean energy needs. He has been a peer reviewer for approximately 45 journals published by ACS, RSC, Wiley, Springer, and Elsevier publishers. In addition, he has served on the grant review panels for the NIH, NSF, DoD, Irish Research Council, and several other international agencies. He has held several leadership roles in the Organic and Biological Electrochemistry division of the Electrochemical Society, USA, and recently completed his Chair term.

<u>Lecture 1:</u> Exploring the Working Principles of Various Commonly Used Electroanalytical Techniques

This lecture will discuss the fundamental working principles of various electroanalytical techniques. These techniques provide valuable insights into the electrochemical properties and behaviors of molecules and systems, offering a deeper understanding of biological, chemical, and environmental processes. By comprehending their working principles, we can implement them for accurate analysis and interpretation of electrochemical data.

Voltammetry: Principles of the cyclic, linear sweep, and pulse voltammetric techniques and their applications in studying redox reactions and electroactive species.

Amperometry: Examining the principles of chronoamperometric measurements and their role in real-time monitoring of electroactive analytes.

Impedance Spectroscopy: Unraveling the principles of impedance spectroscopy, including both faradaic and non-faradaic impedance techniques and their applications in studying charge transfer kinetics and molecular interactions.

Label-Free Capacitance Techniques: Exploring the working principles of label-free capacitance techniques, such as electrochemical impedance spectroscopy, for the detection and characterization of biomolecular interactions and surface modifications.

Nano-Bio Electrocatalysis: Discuss the recent field of nano-bio electrocatalysis and how nanomaterials are utilized to enhance electrochemical reactions and sensitivity in electrochemical biosensors.

Conclusion. By understanding the working principles of these electroanalytical techniques, we gain a deeper understanding of their applications and capabilities. This knowledge allows researchers and analysts to employ these techniques effectively for precise analysis, detection, and characterization in various fields, ranging from biochemistry and medicine to environmental monitoring and energy storage.

Lecture 2: Application of Electroanalytical Techniques in Enzymatic Fuel Cells, Enzymatic Biosensors, Immunosensors, and Biocathodes

This lecture will focus on the diverse applications of electroanalytical techniques in enzymatic fuel cells, enzymatic biosensors, immunosensors, and biocathodes. Electroanalytical techniques play a pivotal role in understanding and optimizing the performance of these bioelectrochemical systems.

Enzymatic fuel cells harness the catalytic power of enzymes to convert chemical energy into electrical energy. Electroanalytical techniques such as cyclic voltammetry and amperometry are employed to characterize the electrocatalytic reactions at the anode and cathode, optimize enzyme immobilization methods, and evaluate the overall performance of these fuel cells such as power density, current potential curves, power density, and operational stability.

Enzymatic biosensors utilize specific enzymes to detect target analytes, offering rapid and sensitive detection in various fields, including healthcare and environmental monitoring. Electroanalytical techniques, such as amperometry, are essential for transducing the enzymatic reaction into measurable current signals (e.g., glucose sensor), enabling quantification and analysis of the target analytes.

Immunosensors rely on the specific recognition between antibodies and antigens to detect biomarkers or pathogens. Electroanalytical techniques, including cyclic voltammetry, square wave voltammetry, amperometry, and impedance spectroscopy, have offered sensitivity and biological selectivity.

Biocathodes are biologically modified electrodes that facilitate the reduction of oxygen to water or other electron acceptors in bioelectrochemical systems. Electroanalytical techniques, such as cyclic voltammetry and chronoamperometry, are employed to study the kinetics of oxygen reduction reaction, optimize electrode materials, and enhance the performance of biocathodes.

Conclusion. Overall, the application of electroanalytical techniques in enzymatic fuel cells, enzymatic biosensors, immunosensors, and biocathodes provides valuable insights into their operation, performance optimization, and analytical capabilities. Understanding the principles and applications of these techniques enables advancements in energy conversion, bioanalytical sensing, and biotechnology with implications in healthcare, environmental monitoring, and beyond.

Hands-on session:

Join us for an exciting hands-on session on electrochemical techniques, where students will drive into the fascinating world of chemical reactions and electrical processes. Don't miss this opportunity to engage in interactive experiments and enhance your understanding of electrochemistry firsthand!

List of Experiments:

1) Electrochemical sensing of dopamine.
   i. Cyclic Voltammetry
   ii. Chronoamperometry

2) Electrochemical impedance spectroscopy at various DC potentials of dopamine sensing.