VITALITY OF ELECTRODES IN THE MODERN ERA

Abstract

A semiconductor or conductor that contacts the solution ofelectrolyte directly is called an electrode. An electrode is used to realize both the input and the output in an electrochemical system. Gold, silver, platinum, mercury, semiconductor materials anda variety of carbon resources, and are some of the substrate materials for regularly used electrodes.

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Author

S. Alwin David
Department of Chemistry
V.O.Chidambaram College
Tuticorin-628008, Tamil Nadu, India

P. Ram Kumar
Department of Chemistry
V.O.Chidambaram College
Tuticorin-628008, Tamil Nadu, India

R. Emelda
Department of Chemistry
SreeSastha Institute of Engineering and Technology
Chembarambakkam Chennai Affiliated by Anna University

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I. MERCURY ELECTRODES

A traditional electrode material is mercury. The cathodic potential window can be extended with a strong hydrogen overvoltage. Mercury electrodes, on the other hand, have a flat surface that is extremely repeatable, renewable, and helpful in electrochemical investigation. As a result, several types of mercury electrodes, such as mercury film electrodes and electrodes that drop mercury have been developed [1].

The falling mercury electrode is the kind of mercury electrode which is most frequently employed. The primary benefit of using this electrode is that it be able to self-renewing, eliminating the requirement for maintenance prior to each experiment. Furthermore, the surface of every mercury drop is uniformly clean. However, the function of the electrodes made up of mercury in the study for biologic genus has been constrained by the mercury toxicity.

II. METAL ELECTRODES

Silver, gold, and platinum, have all been utilized extensively as substrates of electrode. Inert metal electrodes are able to provide a broad anodic potential range and extremely favorable electron transfer kinetics. Other metals can be used as substrates of electrode in addition to noble metal electrodes. Additionally, alloy electrodes with bifunctional catalytic mechanisms, such as nickel-titanium and platinum-ruthenium electrodes were identified and they are frequently utilized in the fuel cells construction [2].

III. CARBON ELECTRODES

Various electrodes have been created using a range of carbon-based compounds as electrode substrates. These electrode surfaces can be renewed easily for the electron exchange because of the flexible characteristics of carbon. Lowbackground current,Broad potential window, comparative chemical inertness, and rich surface chemistryare other characteristics of carbon based materials.

Carbon-based materials are also relatively inexpensive. As a result, carbon electrodes are frequently utilized nowadays. Glassycarbon electrodes (GCE), Pyrolytic graphite electrodes (PGE), carbon fibre electrodes, carbon paste electrodes, and electrodes made of carbon composites are some of the frequently used carbon electrodes [3].

IV. CONDUCTING POLYMER–MODIFIED ELECTRODES

Organic polymers with semiconductor or metallic conductivity characteristics are referred to as conducting polymers. In1977, variousordered conducting and well-characterized polymers have been used because the detection of high conductivity in doped polyacetylene [4]. As a result, various conducting polymer-modified electrodes have been created for the investigation of proteins and cells.

Conducting polymer-modified electrodes have various benefits. One the one hand, non-aqueous mediums with high activity can support the functioning of the majority of proteins [5]. The electrochemical measurements forcells and proteins can be made easier by

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conducting polymers, which often have electronic states that can be emptied and reversibly occupied with electrochemical procedures [6].

V. CHEMICALLY MODIFIED ELECTRODES

Proteins beneath study are frequently immobilized on the electrode surface in research studies. Conversely, the conformational shift caused by this immobilization process could denaturalize most proteins, which could have an impact on future protein analyses. Because of this, bare electrodes are not the best interfaces for obtaining electrochemical characteristics of the majority of proteins; therefore, CMEs are being created to help.

CMEs first appeared in 1973 after Lane and Hubbard used chemisorption to modify several olefin molecules on a pristine platinum electrode, which drastically altered the electrode's electrochemical response [7].

VI. SELF-ASSEMBLY MONOLAYER

It is a phrase used to portray processes in which a collection of spatially disorganised objects arranges itself through small-scale interactions. Ionic, covalent, metallic, and weak interactions (such as van der Waals forces, π–π interactionsand hydrogen bonds,) are among the interactions.

The assembling system can't stand alone. It needs a strong foundation, thus an electrode is a great support that can also serve other purposes. SAM has many benefits. The monolayer is biocompatible and chemically stable for electrochemical examination, for instance, and the production of a SAM only necessitates a straightforward method [8].

VII. MEDIATOR-MODIFIED ELECTRODES

A appropriate electron transfer mediator can speed up redox processes on the surface of an electrode [9]. The following benefits of mediator-modified electrodes over naked electrodes are listed.

First off, it can lower the analyte'soverpotential and any potential background current interference. Second, by improving the current signal's responsiveness, a lower detection limit can be attained. Thirdly, it is possible to avoid product and analyte adsorption. As a result, by utilizing electrodes designed to hold mediators, the analyses' sensitivity and selectivity can be considerably increased.

VIII. NANOMATERIAL-MODIFIED ELECTRODES

Nanomaterials have minimum one dimension that is between 1 and 100 nm in size . They have distinct geometrical, mechanical, electrical, chemical, as well as quantum, surface, and other macroscopic-materials-unique features, such as the influence of small size, surface tension, etc. The wide spectrum of uses for nanomaterials in electronics, medicine, biomaterials, energy production, environmental science, and biosensors has been strongly influenced by these features.

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Electrodes made of nanomaterials provide a number of benefits over electrodes made of conventional materials. First off, nanoparticles provide a significant amount of surface area that can be used to immobilize more useful molecules on electrodes. Second, some semiconductor nanomaterials might encourage electrochemical interactions by increasing the pace at which electrons move from electrodes to proteins. Thirdly, certain biocompatible nanomaterials can support cells or proteins in continuing to function on an electrode for an extended amount of time [10].

In order to undertake electrochemical analysis, a number of nanomaterials have been synthesised and characterised. Metal nanomaterials, particularly gold nanoparticles (AuNPs), carbon nanotubes (CNTs), metallic oxide/sulfide nanomaterials, grapheneand particularly multiwalled carbon nanotubes (MWCNTs), are some of the frequently used nanomaterials.

IX. CONCLUSION

Electrodes are mostly used to generate electrical current and transport it through non-metal things to basically change them in differentmethods. Conductivity can be measured using electrodes. Other applications for electrodes include electrolysis, electroplating, welding, cathodic protection, membrane electrode assembly, Taser electroshock weapons, and chemical analysis, to name a few. Electrodes are also utilised in defibrillators, electroconvulsive therapy, and other medical devices. In biomedical research, electrodes are also employed for electrophysiological methods.

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