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Synthesis and Characterization of Reduced Graphene Oxide Supported Ag/PANI Nanocomposite as Electrochemical Sensor for the Detection of Selected Toxic Heavy Metals

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ABSTRACT:

Reduced graphene oxide supported Ag/PANI nanocomposite electrochemical sensor was synthesized through electrochemical methods from electrochemical polymerization of 0.2M aniline monomer in 1M HCl and electrodeposition of silver nanoparticles from AgNO3on a reduced graphene oxide modified bare electrode. The as synthesized (Ag/PANI/RGO) nanocomposites modified electrode was further characterized by Cyclic Voltammetry. The results show that Ag/PANI/RGO nanocomposite was the highest electroactive substrate than PANI and PANI/RGO. This is due to reduced graphene oxide and synergetic effects as well as electrocatalytic properties of silver nanoparticles. For comparing and as well as for spectroscopic characterization; PANI, PANI/RGO and Ag/PANI/RGO nanocomposites were synthesized by chemical precipitation methods using APS, (NH4)2SO4 as an oxidant and characterized by CV, FTIR, SEM, XRD and UV-Vis and the results showed that a comparable electrochemical properties, optical and structural properties and uniform distribution of silver nanoparticles on the surface of PANI/RGO were observed on SEM micrographs. Fast electron transfer properties were calculated from standard rate constant for electrochemically and chemically synthesized (Ag/PAN/RGO) nanocomposite sensor were koof 71.3x10-3s-1 and 63.9x10-3s-1, respectively. This (Ag/PANI/RGO) nanocomposite electrochemical sensor was carefully tested with the help of anodic stripping voltammetric process as results; linear regression coefficient (R2) of 0.9990 and 0.9977 for Pb2+ and Cd2+, respectively, were obtained. The results have shown that for surface water, specifically for Cd has higher value than the WHO (2008) recommended maximum admissible limits. This is an indication of pollution hazards and weak drinking water treatment practices in the areas, which in turn have important human health implications. Therefore, the government and other responsible authorities to take appropriate corrective measures.

PANI and polypyrrole (PPy) are the most common amongst conducting polymers. More than 10,000 papers on various aspects of PANI chemical, physics and engineering appeared in the last 30 years, according to the web of science. This is because the raw materials are cheap and readily available, synthesis is simple, environmental stability is good, high electricity is high and doping/dedoping is simple chemistry. The polymer-metal nanoparticles promise the prospect of small particles enhancing properties; while the polymer matrix provides versatile functions for host-guest interactions to ensure that the metal nanoparticles expand and disperse. Organic-inorganic hybrid materials prepared by the approach to sol-gel received much interest in the field of material sciences. A mechanical and chemical stability is supported by organic polymer parts, while inorganic parts support ion sharing behaviour and thermal stability. As electrochemical interchangeable ion exchangers for water treatment, particularly water softening, these modified composite materials can be applied. A synthesis of hybrid hybrid ion exchangers could open up new avenues for organometallic chemistry (organic host chemistry, hydrometallurgy), catalysis and antibiotics purification hydrometallurgy and radioactive isotopes, as well as widespread application in the treatment of water and in the control of pollution.

There are therefore expected to be many possibilities for organic inorganic hybrids as new composites. The mixture can also be used for altering or changing inorganic glass materials with organic polymers. The hybrid materials can be regarded, in addition to these characteristics, as modern composite materials which display very different proprieties from their original components, in particular in hybrids of molecular level, organic polymers and inorganic materials. There has also been a great deal of attention given to the synthesis of polymeric / inorganic composites, which has given modern materials different mechanical, chemical, electrochemical, optical and magnetic properties.

Some such excellent materials for ion exchange were developed and successfully used for chromatography. An inorganic ion exchanger is an interesting material based upon an organic polymer matrix because the mechanical stability of the inorganic ion exchanger is due to its existence and fundamental characteristics in relation to the degree of selectiveness of certain metal ions. The synthesis of these hybrid ion exchangers with a strong ability to exchange ions, high stability, reproductively and selectivity for heavy metal ions was also considered to prove that they are suitable for environmental applications. Owing to their tetravalent metals selectivity and intercalation properties, synthetic ion exchangers have been the subjects of significant research in recent years. Because of their excellent ion exchange Zirconium-based exchanger is given attention.

Actions and some important chemical developments in the field of ion exchange, ion exchange membrane and solid state electrochemistry. Goward et al. documented the systematic isolation of Pb2+ by using polyaniline Zr (IV) tungsta phosphate nanocomposite ion exchanger. The literature shows the behaviour, which was studied for the synthesis, ion exchange activity, and for the purpose of study by a variety of three-component ion exchangers, namely zirconium (IV) iodo oxalate, zirconium (IV) phosphor silicate, zirconium (IV) phosphoborate and Zirconium (IV).This thesis explores the ion exchange properties of the polyaniline Zr (IV) iodate as a current ion exchanger, as well as the characterisation and analysis.