SYNTHESIS AND STUDIES ON ION EXCHANGE BEHAVIOR OF NEWLY DEVELOPED COMPOSITE MATERIALS AND THEIR APPLICATIONS

Abstract

In the last decade, ion-exchangers have been used extensively in the chemical decontamination process for metal ion recovery, regeneration of decontaminants, removal of the formulation chemicals from the coolant and aqueous effluents. Advancement of inorganic ion-exchangers is not only due to high thermal stability and resistivity but also for unusual selectivity for ionic species and versatility in separation sciences. Organic–inorganic hybrid ion exchange materials are hi-tech because they can present simultaneously both the properties of an inorganic molecule besides the usual properties of polymer (an organic molecule). Nowadays, nano-composites lead to unexpected new properties exhibiting a vast application potential which are often not exhibited by individual compounds and thus open a new avenue for chemists, physicists and materials scientists. The general class of nano composite organic/inorganic materials is a fast growing area of research. These hybrid materials are currently the objects of intensive research, because they combine in a single solid both the attractive properties of a mechanically and thermally stable inorganic backbone and the specific chemical reactivity and flexibility of the organo-functional group. The creation of organic/inorganic nano particle composites having unique physical properties has attracted intensive research recently. These combined properties of the hybrid nano structured materials with diverse applications attract great attention in the fields of material science heterogeneous catalysis separation science, and fuel cells.
Industrial and mining waste water are the major source of pollution by heavy metals. Heavy metals such as lead, mercury, arsenic, copper, zinc and cadmium are highly toxic when adsorbed into the body. So every possible care should be taken to keep them isolated from getting mixed into the environment. For this purpose, various competent technologies including membrane process, precipitation, adsorption, electrosorption and ion-exchangers were developed to remove the heavy toxic metal ions from the polluted water. Nowadays, nano-composites lead to unexpected new properties exhibiting a vast application potential which are often not exhibited by individual compounds and thus open a new avenue for chemists, physicists and materials scientists.

**Aim of the presented work**

The main objective of our proposed research work is to synthesize advance class of organic-inorganic cation and anion exchange materials and apply these materials in analytical and electroanalytical applications.

Thus the presented research focused at exploring the synthesis of newly developed nanocomposite materials ie Poly-o-toluidine Sn(IV) tungstoarsenate, Poly-o-anisidine Sn(IV) arsenophosphate and Alumina based Polyacrylonitrile nanocomposite anion exchanger and their analytical applications.

The finding of this research has been divided into chapters emphasizing on different characteristics and application of the above mentioned synthesized nanocomposite materials

**Chapter 1**

General Introduction: This chapter presents a brief Introduction of ion exchange chromatography, composite materials and ion selective electrodes. An exhaustive literature survey of synthetic inorganic ion exchangers, Organic-inorganic composite materials and Ion selective electrodes and their application in Analytical Science has been also recorded here.
Chapter 2

This chapter represents the preparative conditions and physicochemical properties of nanocomposite cation exchange materials Poly-o-toluidine Sn(IV) tungstoarsenate and Poly-o-anisidine Sn(IV) arsenophosphate. The characterization of proposed materials was done by various instrumentation techniques like SEM, TEM, TGA-DTA, X-ray, FTIR and Elemental Analysis etc.

Chapter 3

This chapter briefly describes the ion exchange properties of Poly-o-toluidine Sn(IV) tungstoarsenate and Poly-o-anisidine Sn(IV) arsenophosphate along with their adsorbtive behavior for heavy toxic metal ions.

Chapter 4

This chapter represents the preparation, characterization and fabrication of ion-exchanger membranes using Poly-o-toluidine Sn(IV) tungstoarsenate and Poly-o-anisidine Sn(IV) arsenophosphate nano-composite cation exchange materials and their electro analytical application as ion-selective membrane electrode.

Chapter 5

This chapter focused on the most versatile analytical application of Poly-o-toluidine Sn(IV) tungstoarsenate and Poly-o-anisidine Sn(IV) arsenophosphate nano-composite cation exchange materials in separation of toxic metal ions and in potentiometric titration by using ion selective membrane electrode of these composite materials.
Chapter 6

This chapter focuses on the preparation and characterization of Alumina based Polyacrylonitrile Nano Composite as an Anion-exchanger. It’s Electroanalytical application as $\text{AsO}_3^{3-}$ Ion-selective Membrane Electrode. The characterization of proposed materials was done by various instrumentation techniques like SEM, TEM, TGA-DTA, FTIR and Elemental Analysis etc.

Chapter 7

Conclusion of the presented research work has been drawn. Hopefully the physico chemical properties and analytical applications of the developed nano composite materials will be helpful and encouraging resource for various analyst as well as environmental scientist for further research work in this field.
LIST OF PUBLICATIONS


5. Characterization and ion-exchange behavior of thermally stable nano-composite Poly-o-toluidine Sn(IV) tungstoarsenate: Its analytical application in separation of toxic metals Asif Ali Khan*, Umme Habiba (Under review)


7. Preparation and Characterization of Alumina based Polyacrylonitrile Nano composite as an Anion-exchanger: Its Electroanalytical Application as As(III)
Ion-selective Membrane Electrode. Asif Ali Khan*, Umme Habiba (Communicated)


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