Analytical and Electroanalytical Studies of Synthetic Composites

Abstract

Composites are 21st century materials used to meet the demand of improved materials and possess a combination of several desirable properties. With time the research conducted on studying more properties and improving the manufacturing process of composite material has increased. Hybrid materials, which consist of organic–inorganic materials, are of profound interest owing to their unexpected synergistically derived properties because they can present simultaneously both the properties of an inorganic molecule besides the usual properties of polymer (an organic molecule) with better chemical, mechanical, and thermal stabilities and reproducibility. The composite materials possessing ion-exchange properties have recently drawn particular interest because ion-exchange is important for a variety of applications such as water treatment, chemical separation, and electrochemical sensing indicating its usefulness in environmental applications.

The emphasis over industrialization is polluting the natural water day by day by the release of untreated or partially treated water, as well as effluent from sewage treatment plant (that are not performing tertiary treatment) containing toxic compounds into the public sewage or on land. Due to economic as well as good ion-exchange properties composite cation-exchangers will be promising candidates for the removal of heavy toxic metal ions over inorganic ion exchangers or organic resins because of their inherent drawback in terms of chemical and temperature stability, respectively.
Aim of the presented work

Attainment of real processibility and applicability of ‘organic-inorganic’ nano composite cation exchanger in analytical and electroanalytical field is the main aim of the present work.

Thus the presented research focussed at exploring the application of polyaniline, polypyrrole and PMMA based synthetic nanocomposites i.e. Polyaniline zirconium titanium phosphate (PANI-ZTP), Polypyrrole zirconium titanium phosphate (PPy-ZTP), Polyaniline zirconium tungstiodophosphate (PANI-ZWIP) and Poly (methylmethacrylate) cerium molybdate (PMMA-CeMoO₄) having excellent ion-exchange properties.

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
1(a). General Introduction The section of this chapter presents a brief introduction of composite materials, ion chromatography, ion selective electrode, conducting and non conducting polymers with their historical background and their application in analytical science.
1(b). Literature survey An exhaustive literature survey of synthetic inorganic ion exchangers, ‘Organic-Inorganic’ composite material and important ion selective electrodes of analytical utility has been recorded here.

Chapter 2

This chapter represents the preparative conditions and physico-chemical properties of conducting composite cation-exchange materials PANI-ZTP, PPy-ZTP and PANI-ZWIP. The characterization of proposed materials was done by various instrumentation techniques like TEM, SEM, FTIR, TGA-DTA, X-Ray, AAS, Elemental analysis etc.

Chapter 3

It briefly describes the ion-exchange properties of PANI-ZTP, PPy-ZTP and PANI-ZWIP nanocomposites along with their adsorption behavior for heavy toxic metal ions.
Chapter 4

In this chapter, we report the electrical conductivity behavior of nanocomposites PANI-ZTP, PPy-ZTP and PANI-ZWIP with increasing temperature by using 4-in-line-probe dc electrical conductivity measuring instrument.

Chapter 5

Here it summarizes the electroanalytical application of prepared nanocomposites PANI-ZTP, PPy-ZTP and PANI-ZWIP, having high selectivity for toxic metal ions (mercury, thorium and copper) in the field of separation science. Efforts have been made to fabricate ion-selective membrane electrode which act as potentiometric sensor having high sensitivity and selectivity for selective toxic metal ions.

Chapter 6

In this chapter, we propose a new method to prepare poly (methyl methacrylate) cerium molybdate (PMMA-CeMoO₄) nanocomposite by free radical suspension polymerization using water as a medium, with in situ ‘sol–gel’ transformation. The morphology, structural properties and electroanalytical application has been discussed.

Chapter 7

The chapter focuses on practical applications of PPy-ZTP nanocomposite as potentiometric sensor for determination and analysis of cationic surfactant, cetyl trimethyl ammonium bromide (CTAB) in aqueous solution.

Chapter 8

The chapter presents a relatively simple, rapid, sensitive and selective spectrophotometric and electroanalytical method for determination of Thiram using prepared nanocomposite cation exchanger PANI-ZTP.

Chapter 9

Conclusion and future scope of the presented research work has been drawn. Hopefully, the findings of this research work will be an encouraging resource for the analytical community as well as environmental scientists for further research work in this field.
LIST OF PUBLICATIONS


10. Analytical application and Kinetic studies of polypyrrole zirconium titanium phosphate Nanocomposite
   Asif Ali Khan, Leena Paquiza (Communicated).

11. Physicochemical characterization and conducting behaviour of newly synthesized nanocomposite polyaniline zirconium tungstoiodophosphate
   Asif Ali Khan, Leena Paquiza (Communicated).

12. Ion exchange kinetics of polyaniline based nanocomposites.
   Asif Ali Khan, Leena Paquiza (Communicated).

ABSTRACT PUBLISHED

1. 27th Annual conference of Indian Council of Chemist, Haridwar, India 2008
   (Got young scientist award for presenting full paper).

