



A Comparative Study - The Ion Exchange Properties of Nanosized Cerium Molybdo Iodate and Cerium Phospho Iodate

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ABSTRACT

Nanoparticles of cerium molybdo iodate and cerium phospho iodate, tetravalent metal acid (TMA) salts were prepared by chemical co-precipitation method. The protons present in the structural hydroxyl groups indicate good potential for TMA salts to exhibit solid state proton conduction. The samples in its protonated form were subjected to ion exchange capacity studies. The data revealed that the samples act as a good ion exchangers.

Key words: Cerium molybdo iodate, Cerium phospho iodate, Ion exchange capacity.

INTRODUCTION

Nowadays people are very much interested in the study of ion exchange materials of the class tetravalent metal acid salts because of their selectivity and intercalation properties^{1,2,3,4}. Ion exchangers have wide range of applications in water processing such as desalination and in the chemical industries. Heteropolyacid salts such as tin(IV), titanium(IV), zirconium(IV), cerium(IV) have been reported in the literature as ion exchange materials. Properties of these materials are comparatively better than their simple metal salts. The present study is concerned with the ion exchange capacities as the cation exchanger of nanoparticles of cerium molybdo iodate and cerium phospho iodate.

EXPERIMENTAL

Nanoparticles of cerium molybdo iodate (CMI) and cerium phospho iodate (CPI) were prepared by arrested precipitation from equi molar solutions of analytical grade ammonium ceric sulphate, sodium molybdate, disodium hydrogen ortho phosphate, potassium iodate for which ethylene diamine tetra acetic acid was used as the capping agent⁵. A definite volume of each solution of the salts was added into the EDTA solution kept under a constant stirring with a magnetic stirrer. Precipitates of the salts were thus formed. It was separated and washed several times with distilled water and finally with ethanol to get a pure sample. It was then dried and grounded to fine powders. The samples obtained were sized by sieving to 30-

60 mesh size and converted to the hydrogen form completely by repeated treatment with 1M HCl, washed with demineralized water till free from chloride ions and then dried at 45°C.

The ion exchange capacity of the protonated sample was estimated by the column process. One gram of the exchanger (H⁺ form) was packed in a glass column and washed with demineralized water to remove any excess of acid that remained on the particles. 250ml of 1M solution of different salts was passed through the column maintaining the flow rate at 1mlmin⁻¹. The effluent was collected and titrated against a standard NaOH solution to estimate the total H⁺ ions released.

RESULTS AND DISCUSSION

XRD line broadening study of cerium

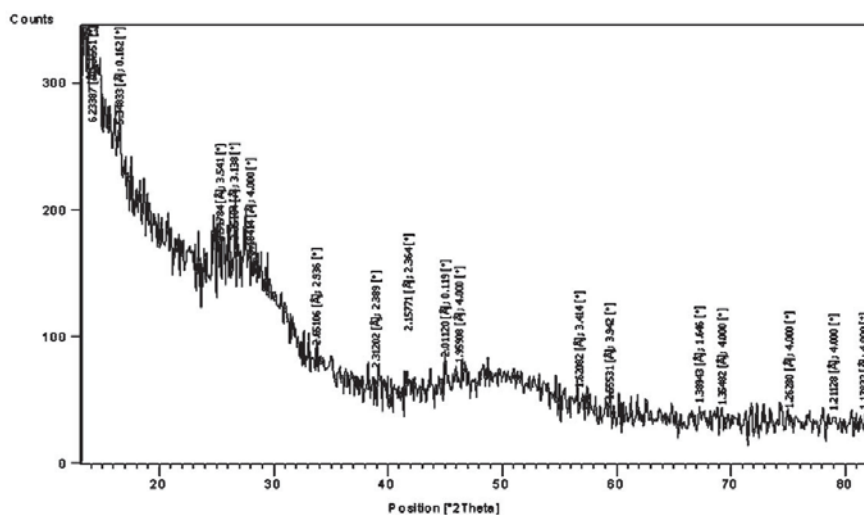
molybdo iodate and cerium phospho iodate reveal that the particles formed are nanocrystalline. The size of the synthesized nanoparticles calculated using Scherrer equation is found to be below 30nm for both cerium molybdo iodate and cerium phospho iodate. The nanocrystals have lesser lattice planes compared to the bulk, which contributes to the broadening of peaks in the diffractogram. This broadening of the peaks could also arise due to the micro straining of the crystal structures arising from the defects like dislocations and twinning. These are believed to be associated with the chemically synthesized nanocrystals as they grow spontaneously during the chemical reaction. As a result, chemical ligands get negligible time to diffuse to an energetically favorable site. It could also arise due to the lack of sufficient energy needed by an atom to move to a proper site in forming the crystallite.

Table 1(a): The result from the study of ion exchange capacity of CMI

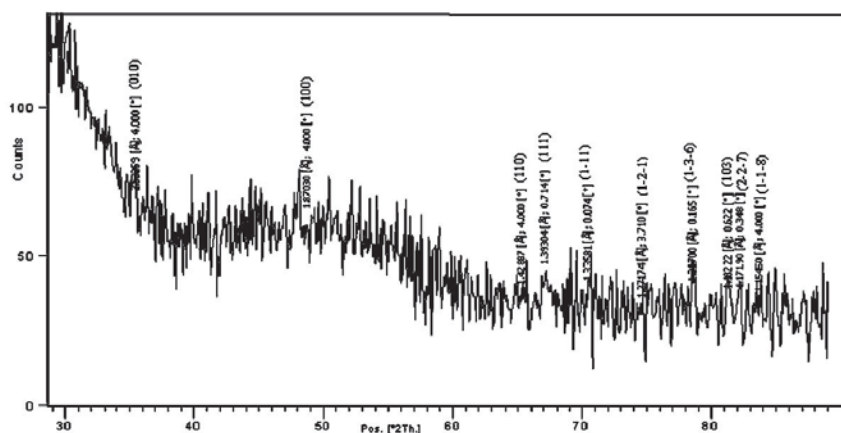
S. No.	Cation	Salt used	i.e.c (meqg ⁻¹)
1.	Li ⁺	LiCl	0.8872
2.	Mg ²⁺	MgCl ₂	0.555
3.	Sr ²⁺	Sr(NO ₃) ₂	0.7948
4.	Ca ²⁺	(CH ₃ COO) ₂ Ca	4.0665
5.	Ba ²⁺	BaCl ₂	0.6099
6.	Na ⁺	CH ₃ COONa.3H ₂ O (RT)	3.5675
7.	Na ⁺	CH ₃ COONa.3H ₂ O (175 °C)	4.936
8.	Na ⁺	CH ₃ COONa.3H ₂ O (350 °C)	9.31
9.	Na ⁺	CH ₃ COONa.3H ₂ O (525 °C)	2.914

Table 1(b): The result from the study of ion exchange capacity of CPI

S No.	Cation	Salt used	i.e.c (meqg ⁻¹)
1	Li ⁺	LiCl	0.4259
2	Mg ²⁺	MgCl ₂	0.555
3	Sr ²⁺	Sr(NO ₃) ₂	0.574
4	Ca ²⁺	(CH ₃ COO) ₂ Ca	2.611
5	Ba ²⁺	BaCl ₂	1.0000
6	Na ⁺	CH ₃ COONa.3H ₂ O (RT)	1.9814
7	Na ⁺	CH ₃ COONa.3H ₂ O (175 °C)	1.6016
8	Na ⁺	CH ₃ COONa.3H ₂ O (350 °C)	4.5979
9	Na ⁺	CH ₃ COONa.3H ₂ O (525 °C)	0.5722



XRD pattern of CMI



XRD pattern of CPI

The result from the study of the ion exchange capacities of cerium molybdo iodate and cerium phospho iodate of the protonated samples are shown in the table 1a and 1b respectively. The data reveals that the samples behave as a good ion exchangers.

The values of the ion exchange capacities of Na^+ ions are found to be maximum, when the nanopowders before protonated form is heated at 350°C and minimum, when the nanopowders before protonated form is heated at 525°C .

Variations in the ion exchange capacities of cerium molybdo iodate and cerium phospho iodate for some other ions are also indicated in the table.

CONCLUSIONS

Nanoparticles of cerium molybdo iodate and cerium phospho iodate are prepared by chemical co-precipitation method. The hydrogen form of the sample is found to be a powerful ion exchanger and hence a promising candidate as a good cation exchanger.

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