Adsorption of Ni(II) Ions from Aqueous Solution on the DMSA Functionalized Magnetic Nanoadsorbents

V.P. Kothavale[1], V. D. Chavan[2], S. R. Shingte[3], Subasa C. Sahoo[4], P.S. Patil[2,5], and P.B. Patil[3,a)]

[1]*Department of Physics, BhogawatiMahavidyalaya, Kurukali, Shivaji University Kolhapur- 416001, India.*
[2]*School of Nanoscience and Technology, Shivaji University, Kolhapur-416004, India.*
[3]*Department of Physics, The New College,Shivaji University, Kolhapur, Maharashtra -416012, India.*
[4]*Department of Physics, Central University of Kerala, Kasaragod-671316, India.*
[5]*Department of Physics, Shivaji University, Kolhapur, Maharashtra -416004, India.*

[a)] Corresponding author: prashantphy@gmail.com

Abstract. The magnetic nanoparticles (MNPs) were synthesized by the thermal decomposition method and functionalized with meso-2,3-dimercaptosuccinic acid (DMSA). The MNP-DMSA were used as a nanoadsorbents for the removal of Ni(II) ions from aqueous solution. MNPs were characterized by X-ray diffraction (XRD), field emissionscanning electron microscopy (FESEM), and vibrating sample magnetometer (VSM). The MNPs have magnetite phase with a particle size around 25 nm.The magnetic measurement showed that MNPs exhibits superparamagnetic nature with a saturation magnetization of 44 emu/g. The batch adsorption experiments were carried out to remove Ni(II) by optimizing the contact time and initial Ni(II) concentration. The maximum 60 % efficiency was achieved for Ni(II) metal ions removal from the aqueous solution.

1. INTRODUCTION

Industries like a metallurgical, tannery, chemical manufacturing, mining, pesticides, and battery manufacturing have been releasing enormous heavy metals into water resources. Water contamination by heavy metals is harmful to human health and also to the ecological system. Therefore it is necessary to remove the heavy metals from polluted water efficiently[1]. There are various physiochemical methods such as ion exchange, solvent extraction, coagulation, chemical precipitation, adsorption, membrane separation, ultrafiltration, etc. for the removal of heavy metals from wastewater. Among these methods, adsorption is the most common method due to its low operating cost, high-efficiency, and easy operational conditions[2]. Several adsorbents like carbon nanotubes, activated carbon, silica gel, clay minerals, magnetic nanoparticles (MNPs), graphene oxide, etc. have been developed for heavy metal removal[3]. Among these adsorbents, MNPs have a high surface to volume ratio, good colloidal stability, and superparamagnetism withhigher magnetization[4]. In addition to this, after adsorption of metal contaminants, MNPs can be easily separated from wastewater by an external magnetic field. To prevent the oxidation of nanoparticles and to improve the heavy metal adsorption capacity, MNPs can be functionalized with compounds, such as chitosan, EGTA-modified chitosan, humic acid, valine, meso-2,3-dimercaptosuccinic acid (DMSA) etc[2,5]. Functionalized MNPs provides specific functional groups like -COOH, $-NH_2$, -OH, -SH, etc. for heavy metal adsorption and thus it may increase the removal efficiency[6].

In this work, Fe_3O_4 MNPs were prepared by a thermal decomposition method and functionalized by DMSA. The nanoadsorbents MNP-DMSA was employed for the removal of Ni(II) from aqueous solution.

DAE Solid State Physics Symposium 2019
AIP Conf. Proc. 2265, 030573-1–030573-4; https://doi.org/10.1063/5.0016738
Published by AIP Publishing. 978-0-7354-2025-0/$30.00