Received: 17 December 2018 | Revised: 21 April 2019 | Accepted: 22 May 2019

DOI: 10.1002/aoc.5064

FULL PAPER

WILEY Applied Organometallic Chemistry

A modern approach for the sensing of aqueous Al(III) ion by Ni(II) Salen-type Schiff base complexes

Nithya Mohan[1†] | Sreejith S. S.[1†] | P.M. Sabura Begum[1] | M.R. Prathapachandra Kurup[1,2]

[1]Department of Applied Chemistry, Cochin University of Science and Technology, Kochi 682 022Kerala, India

[2]Department of Chemistry, School of Physical Sciences, Central University of Kerala, Tejaswini Hills, Periye, Kasaragod 671 316, India

Correspondence
Prathapachandra Kurup, Department of Applied Chemistry, Cochin University of Science and Technology, Kochi 682 022, Kerala, India.
Email: mrpcusat@gmail.com

Funding information
Cochin University of Science and Technology, Grant/Award Number: 0

In this work, we explore a modern concept of transmetalation (metal exchange) for the effective recognition of aqueous Al(III) ion. Three different Ni(II) salen-type Schiff base complexes with different spacer diimine groups were prepared for the metal exchange reaction. These probes recognize Al(III) both colorimetically as well as fluorimetrically. The efficiency in sensing is mainly due to the low emission characteristics of the respective Ni(II) complexes which results in enhanced emission on the formation of Al(III) complex. The geometry of the central Ni(II) metal ion in the probe plays a pivotal role in the sensing action with the highest sensitivity being shown by the Ni(II) metal center with distorted square pyramidal geometry. Further DFT calculations and the energetics involved in the sensing mechanism *via* the formation of Al(III) complexes substantiates the experimental results.

KEYWORDS
DFT studies, Ni (II) salen complexes, Schiff bases, sensors, transmetalation

1 | INTRODUCTION

A burgeoning interest in the study of Schiff bases and their metal complexes derived from methoxy or substituted aldehydes have a rich history and is now gathering more and more attention owing to their multifaceted applications.[1] Multifaceted applications arise from their multifarious properties in fields such as fluorescent chemodosimeter,[2] magnetic,[3] cell imaging materials,[4] therapeutic agents,[5] photochromic or thermochromic materials *etc*.[6] Each of these properties can be fine-tuned for industrial application which is one of the most propitious features of salen Schiff bases.[7] Among these multitudinous properties, we are interested in chemodosimetric attributes of Salen Schiff bases and their metal complexes for the effective sensing of Al^{3+} ion.

Even though a number of methods or techniques such as potentiometric,[8] electrochemical,[9] atomic absorption spectrometric, inductively coupled plasma mass spectroscopy (ICP-MS)[10] and voltammetric methods[11] are available for the sensing of metal ions, research is going on for an alternative since these techniques have unavoidable limitations like variable degree of expertise in instrument handling, high initial and maintenance cost of instruments *etc*. But the proposed method here provides an online or in-field monitoring of aluminium ion (Al(III)) in a novel dual responsive pathway.

Numerous sensors have already been reported for the detection of toxic metal ions such as Cd(II),[12] Hg(II)[13] but the reports are limited in the field of aluminium ion detection (Al(III)).[14] Even though aluminium is a non-essential element, its detection has great significance since its toxic effect is increasing day by day due to its widespread application in automobiles, electrical equipment, computers, cooking utensils *etc*. Continuous uptake of aluminium causes many serious health issues and it also affects the aquatic lives in acidic rivers.[15] In the survey of reported aluminium sensors, it was found that most of them require complicated synthetic procedure and recognize aluminium ions *via* weak

†Nithya Mohan and Sreejith S. S. have contributed equally to this work.

