

Thiosemicarbazone-based probe for detection and discrimination of a group of toxic transition metal ions and its application in developing logic gate

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1. Introduction – As a result of the growth in mining and industry, heavy metal ions pollution become a major global problem for decades as many of these metal ions are highly toxic and adversely affect human health and environment. Hence over the last few decades, selective and sensitive recognition of heavy transition metal ions have drawn intense attention to increase in concern on human health and environmental safety.¹ Although, zinc, cadmium and mercury belong to the same group in the periodic table (group 12), they exhibit distinct character and play an important role in biological system. In the human organism, zinc is the second most abundant micronutrient behind iron. Zinc ion (Zn^{2+}) serves as an essential ingredient for various enzymes and is essential in neural signal transmission, gene transcription and apoptosis.² Its deficiency causes genetic autosomal disorder, enteropathica however, the imbalance of metabolism of zinc may lead to numerous health problems like superficial skin disease, diabetes, prostate cancer, Alzheimer's disease, Parkinson's disease etc.³ Cadmium is very toxic and carcinogenic metal. On the top twenty hazardous substances reported by the Agency for Toxic Substances and Disease Registry and USEPA, cadmium ranks seventh position.⁴ In contrast, mercury is one of the most harmful and extremely hazardous metal. The exposure to Hg causes a wide array of diseases viz., arrhythmia, cardiomyopathy, neurological disorders, Minamata disease, prenatal brain damage and gastric disorders.⁵ Among various important transition metal ions, Zn^{2+} , Cd^{2+} and Hg^{2+} all are more or less significantly environmental pollutants. Therefore, development of fluorescent sensor (Image 1) for selective and sensitive recognition of these ions is of crucial importance.

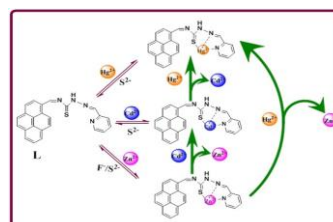


Image 1. Sensing mechanism

2. Results and Discussion - A new simple 3-in-1 multi-response thiosemicarbazone based chemosensor has been synthesized and characterized. The probe exhibited not only high sensitivity towards the most familiar and abundant group 12 metal ions viz., Zn^{2+} , Cd^{2+} and Hg^{2+} in MeCN- H_2O (1:1, v/v) medium but also can efficiently distinguish them through significant changes in their absorption as well as emission spectral behavior. Absorption, fluorescence emission, fluorescence lifetime measurements are the most reliable and accurate techniques to study the binding affinity of the probe towards these metal ions. Due to the observation of different binding affinities and significant changes in absorbance at different wavelength by combination of different inputs, **L** could be judiciously applied for construction of some basic logic gates (AND, OR, NOT, IMPLICATION and INHIBIT).

3. Conclusions – A very precise, sophisticated and low cost technique for selective and sensitive recognition of toxic pollutants have been developed, studied and will be discussed in detail.

4. References

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