



Ain Shams University
Faculty of Science
Chemistry Department

Synthesis, Characterization and Applications of Some Nano Optical Sensors

**A Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of Doctor of
Philosophy (Ph.D.) in Science "Chemistry"**

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**Thesis
Approval**

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DEDICATION

" قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ "

سورة البقرة (32)

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work readily.

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Islam M. El-Sewify

Abstract

Abstract

Student's Name: Islam Mohamed El-said Mohamed El-Sewify

Title of the Thesis: Synthesis, Characterization and Applications of Some Nano Optical Sensors

Degree: PhD of Science (Inorganic and analytical Chemistry)

In this thesis, water-stable, optical nanosensors using Zr-based metal-organic frameworks (MOFs) as platforms were fabricated for selective determination of the ultra-traces of heavy metals, such as Bi^{3+} and Zn^{2+} ions from water resources. The constructions of optical nanosensors was advanced via direct decoration of hydrophobic optical probes into the Zr-based metal-organic frameworks (MOFs). Significantly, the optical nanosensors design with super-microgroove pores, uniform, long-range intergrowing crystal, and dense decoration of optical probes, leading to create active hook surface sheaths as sensitive and selective chemosensors scaffold for ultra-trace monitoring of Bi^{3+} and Zn^{2+} ions. The supermicro-crystal structures of optical nanosensors have revealed synergistic enhancement in selective sensing assay associated with low-detection limit up to part-per-billion (ppb), wide-range determination and fast response monitoring in the order of second during the binding of target. The selectivity of heavy metal ions fluorometric sensing process in a heterogeneous mixture of inorganic cations and anions was mainly dependent on the structure of the optical probe, pH condition, competitive ion system composition, and metal ion-to-optical probe binding procedure. Our developed optical nanosensors showed a wide range of detection of Bi^{3+} and Zn^{2+} ions with a considerably low detection limit in optimal

working condition. The long-term stability of optical nanosensors with fluorescent surface functionality enabled the practical and multiple reuse/cycles of Bi^{3+} and Zn^{2+} ion determination.

Keywords: metal-organic frameworks (MOFs); heavy metal; optical probe; ultra-traces; chemosensors; part-per-billion (ppb); intergrowing crystal

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