Novel Thiophene-Derived Schiff Base as a Fluorescent Sensor for Highly Sensitive and Selective Relay Recognition of Zn^{2+} and Fe^{2+} ions

I. Hamzi[1,2,*], Y. Mered[1], B. Mostefa-Kara[1]

[1]Laboratoire de Catalyse et Synthèse en Chimie Organique, Faculté des Sciences, Université de Tlemcen, B.P.119, Tlemcen 13000, Algeria.

[2] Faculté de Médecine, Université de Tlemcen, 12 B P 123 Hamri Ahmed, Tlemcen 13000, Algeria.

*Correspondence: imane.hamzi@univ-tlemcen.dz

Abstract:

Chemosensors based on Schiff bases are pivotal in environmental and biological applications, serving to identify specific metal ions at trace levels. Despite the distinctive importance of thiophene-based molecules in medicinal contexts, the number of reported chemosensors utilizing these moieties remains limited.

In this study, we present the synthesis and characterization of a novel Schiff base sensor (TBH), derived from thiophene-2-carboxaldehyde and benzil. We investigate its application as a selective relay probe for the detection of Zn^{2+} and Fe^{2+} ions.

The introduction of Zn^{2+} to TBH, resulted in a significant enhancement of fluorescent intensity, attributed to the formation of a 1:1 TBH–Zn^{2+} complex, with no response observed for other cations, including Mg^{2+}, Ba^{2+}, Cd^{2+}, Cu^{2+}, Co^{2+}, Mn^{2+}, Cr^{3+}, Hg^{2+}, Sn^{2+}, La^{3+}, Ca^{2+}, Na^{+}, K^{+}, and particularly Fe^{2+}. Furthermore, Fe^{2+} induced fluorescence quenching in the TBH–Zn^{2+} system, forming a 1:1 MY–Fe^{2+} complex. The TBH-Zn^{2+} solvento-complex demonstrates potential as a secondary sensor for Fe^{2+} ions. The sensor's signal change is based on the chelation-enhanced fluorescence (CHEF) effect of TBH–Zn^{2+}, coupled with the inhibition of photoinduced electron transfer (PET).

Moreover, the rapid and selective features of the proposed sensor make it promising for the precise monitoring of Zn^{2+} and Fe^{2+} in biological and environmental research.

Keywords: Schiff-base Derivatives, Thiophene, Fluorescent chemosensor, Ion Detection.