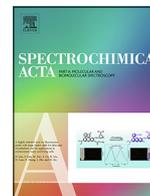




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## Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy

journal homepage: [www.elsevier.com/locate/saa](http://www.elsevier.com/locate/saa)Simple SPR-based colorimetric sensor to differentiate  $Mg^{2+}$  and  $Ca^{2+}$  in aqueous solutions

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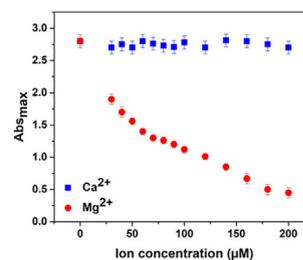
## HIGHLIGHTS

- A simple colorimetric probe was developed for the rapid and accurate determination of  $Mg^{2+}$ .
- The developed sensor detected  $Mg^{2+}$  ions in the dynamic range of 1–200  $\mu M$ .
- The L-tryptophan-AgNPs sensor responded selectively to  $Mg^{2+}$  in the presence of  $Ca^{2+}$  in urine samples.
- The limit of detection for detecting  $Mg^{2+}$  was as low as 3  $\mu M$  even in the complex solutions.

## GRAPHICAL ABSTRACT



L-tryptophan functionalized silver nanoparticles as a simple colorimetric probe to differentiate  $Mg^{2+}$  and  $Ca^{2+}$  in aqueous solutions



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## ABSTRACT

L-tryptophan functionalized AgNPs were successfully fabricated using a one-pot synthesis method and assessed as a colorimetric probe for rapid and accurate determination of  $Mg^{2+}$  ions. The developed sensor showed a selective response towards  $Mg^{2+}$  with no interference from  $Ca^{2+}$  in the wide concentration range of 1–200  $\mu M$ . The sensor's response was optimized in the pH range of 9–10, which can be attributed to the protonation of amine groups and their interaction with  $Mg^{2+}$  ions. The stability and selectivity of the sensor were examined in different salt (NaCl) and other metal ions, respectively. The L-tryptophan-AgNPs sensor detected  $Mg^{2+}$  with the limit of detection of 3  $\mu M$ , which is way lower than the concentration range of magnesium in human serum (0.75–1.05 mM). The recovery values of the developed sensor were in the range of 96–102% for the determination of  $Mg^{2+}$  in urine samples. The obtained performances proved the potential application of the developed sensor for clinical diagnostic of  $Mg^{2+}$  ions where an accurate and rapid response is needed.

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## 1. Introduction

Alkaline earth metal (AEM) ions play a crucial role in living systems, such as stabilizing cell membrane, DNA and RNA conformations, and cofactor for hundreds of enzymatic reactions [1–4]. Magnesium ( $Mg^{2+}$ ) is the most abundant intracellular divalent AEM cation, regulating daily metabolism, cell growth and reproduction, neuronal activity, and blood pressure [5–9]. The normal

concentration of  $Mg^{2+}$  in human serum ranging from 0.75 mM to 1.05 mM [10]. Both hypomagnesemia and hypermagnesemia may cause critical health problems, so accurate and rapid detection in serum samples is of great importance. It should be mentioned that only 1% of the total  $Mg^{2+}$  present in the body can be detected using clinical testing [10]; hence usually, its level is measured within 24 h for the most accurate result. In this condition, using conventional analysis methods such as inductively coupled plasma-mass spectrometry (ICP-MS) and atomic absorption spectroscopy (AAS) for determining  $Mg^{2+}$  could be tedious. Therefore, there is a huge interest for developing simple, rapid, and accurate methods for determining  $Mg^{2+}$  concentration in serum samples.

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