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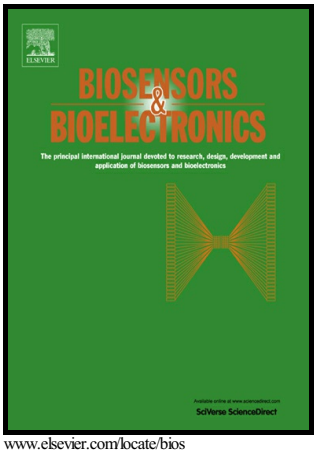

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ABSTRACT

Molecular robot provides a promising way to receive response signals and make decisions with intelligent information processing at the molecule level. In this work, a molecular robot prototype based on a europium(III)-cyclen complex (*EuL*) was designed and assembled, consisting of multiplex sensing and information processing in a single system. By utilizing the Eu^{3+} ion as a central processing unit (CPU) and terpyridine (*Terpy*) group as an arm of the molecular robot, multiplex detection function of this molecular robot can be accomplished in three test channels: the detection of Fe^{2+} with UV-vis, Zn^{2+} using photoluminescence, and Mn^{2+} using magnetic resonance imaging. The optimized structures revealed that the transition metal ions bound by the arms of two *EuL* molecules formed a hexacoordination octahedral rigidity structure in the adducts. For the structure of *L* and *EuL*, three pyridine rings of *Terpy* unit were not in a plane, and they were fixed to form a plane when captured the transition metal ions during the formation of the adducts. In addition, three different modes of molecular logic devices (OR, INHIBIT, and YES) were established based on relevant signals in the multiplex detection channels. The sensing of metal ions in human urine using *EuL* was also carried out, and the result demonstrated the presence of good recoveries and high analytical precision. Such a molecular robot prototype is expected to be used in intelligent medical diagnostics and, in particular, information processing at molecular level.

Graphical Abstract