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Photonic Nanodevice for Monitoring of Potable Water

Ana Clara R. Salazar*, Petrus Santa-Cruz

Departamento de Química Fundamental, LAND-Foton/DQF/UFPE, Universidade Federal de Pernambuco, 50740-540, Recife, Brazil, e-mail: *anaclara@renami.com.br, petrus@pq.cnpq.br.

Abstract – In this work we present a photonic molecular nanodevice for monitoring of potable water. It consists of a superabsorbent polymer functionalized by a photonic marker: a lanthanide complex whose emission spectrum is affected by the chemical neighborhood. Through a fine structure analysis (relative intensities of Stark transitions) of the marker emission spectrum, we are able to detect the presence of metal pollutants, allowing the development of an optical label pattern recognition device.

The spectroscopic properties of lanthanide coordination complexes are well known, and have been studied by our group, aiming to the development of molecular photonic nanodevices [1]. Complexes with Eu^{3+} as central ion can act as structural spetroscopic probes due to the high sensitivity of the Eu^{3+} $^5D_0 \rightarrow {}^7F_2$ transition to the chemical neighborhood. Previous works in the area include a patent deposit and a doctoral thesis [2,3].

This work consists of a photonic molecular nanodevice for monitoring of potable water, which falls into one of the projects to be implemented under the INCT-Inami, Institute of Nanotechnology for Integrated Markers, coordinated at the Department of Fundamental Chemistry, UFPE.

The device is a superabsorbent polymer functionalized by the incorporation of an optically active lanthanide ion (Eu^{3+}) in the form of complex anchored in the structure of the polymer. Potentially polluting metals are detected from the interaction with the photonic marker: the luminescent molecule whose spectrum is influenced by the chemichal neighborhood (Fig.1). The marker is anchored in an acrylic superabsorbent polymer (hydrogel) which acts as a concentrator of pollutants, and the analysis of the fine structure of the photonic marker emission spectrum (relative intensities of transitions between Stark levels) allows us to detect the presence of metal pollutants, comparing with standards for potable water.

Two devices were designed based on this detection mechanism: the first one brings a fast water analysis to home, in a tea sachet packaging of the functionalized hydrogel [4] and the second one, for real time analysis of water reservoir, using an active coated optical fiber system [5]. In both cases the reading of the analysis is performed using an optical label pattern recognition process, in wish the signal of the marker affected by potable water is stored as reference.

The advantages of this device are the speed of detection, its portability, and the use of the same methodology for several metals. In the future we have the prospect of Technology Integration embedded in the same device to analyze also other kinds of pollutants (toxins, bacteria).

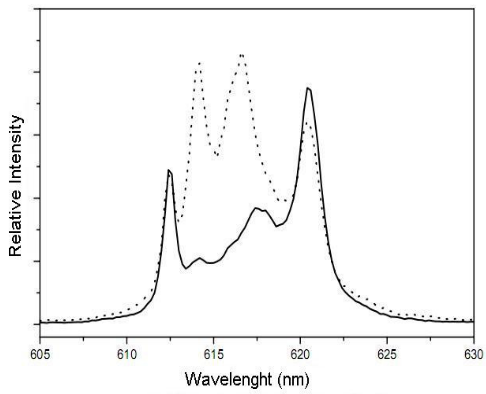

Figure 1: Comparison of the relative intensities of high resolution emission spectrum of Eu^{3+} in the molecular device affected by water contaminated with Mn (II) in full line, and water contaminated with Cu (II) in dotted line.

References

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