OXYGEN SENSING: A REVIEW PART 1: MATERIALS AND METHODS FOR OPTICAL AND GALVANIC LEAD-FREE OXYGEN DETECTION

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Abstract. *This paper reviews two of the most important optical and electrochemical principles for oxygen detection. In the first part it outlines materials and methods for the fluorescence quenching – based oxygen detection (types of fluorophores, strategies for covalent or noncovalent immobilization of fluorophores into the polymeric matrix), while the second part deals with galvanic oxygen sensor and alternatives to replace lead, which is the most used metal as anode in this type of sensors.*

Keywords: Oxygen sensing, Fluorescence Quenching, Polymer Matrix, Galvanic Sensor, Lead-free

1. Introduction

Oxygen is the most abundant element in the Earth's crust and represents one-fifth of the Earth‘s atmosphere. Measuring the oxygen concentration is important in various fields, such as: industrial processes monitoring, automotive, medicine (i.e., anesthesia monitors), food packaging, environmental and marine monitoring [1]. Among the traditional oxygen sensing principles, one can enumerate: electrochemical, chemical (Winkler titration), optical, metal oxide semiconductor sensors, etc. [2, 3].

A lot of working principles - such as reflectometry, fluorescence quenching, infrared and Raman spectroscopy, interferometry, luminescence - have been used in manufacturing oxygen sensors. However, the majority of the optical sensors developed for the oxygen detection in the last years are based on the fluorescence quenching of organic or inorganic fluorophores induced by molecular oxygen.

Among the electrochemical devices for oxygen sensing, galvanic sensors are widely used due to reliability, stability and ease of manufacture. This paper presents a brief review of the materials and methods used in detection of oxygen using fluorescence quenching and lead-free galvanic sensors.

2. Fluorescence–quenching based oxygen sensing

When exposed to light at an appropriate wavelength, the fluorophores (F) absorb energy and are promoted from their ground state energy level (S_0) into an excited state energy level (S_1).

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