**Introduction**

- Fluorescent and phosphorescent dyes have been used to determine pH values and oxygen concentrations in a variety of systems.1
- The goal of this project is to develop a small, self-contained, cheaply processed dual pH/oxygen sensor (Figure 1). Such an instrument could potentially be taken to various environments and quickly and easily provide readings.
- A platinum-porphyrin dye was used based upon its long emission time, high sensitivity, and short response time.2
- The Stern-Volmer Equation \( \frac{I}{I_0} = 1 + k' P_{O_2} \), where \( I \) is phosphorescence intensity in the absence of oxygen, \( I_0 \) is the phosphorescence intensity, and \( k' \) is a rate constant, can be used to determine the concentration of oxygen from the intensity of the emitted light.3
- This project is focused on the development of the oxygen-sensing component of the device.

**Methodology**

- Platinum (II) meso-tetrakis (2,3,4,5,6-penta-fluorophenyl) porphyrin (PtTFPP) (Figure 2) was dissolved in a suspension of polystyrene and titanium dioxide in toluene. This produced a thin, oxygen-sensitive membrane when placed on a surface and allowed to dry (Figure 3).

- An Arduino Uno® microcontroller was programmed using open-source software to control a 405 nm LED and a Hamamatsu Digital Color Sensor S11012-G1CR (Figure 4).

- The PtTFPP paint showed an increase in emission intensity at low oxygen levels when compared to high oxygen levels during a yeast-depletion study (Figure 5).

- Code written for the Arduino Uno® and Hamamatsu Digital Color Sensor, was used to control an LED and determine the percentage air saturation of a sample (Figures 6, and 7). Data was collected simultaneously by a Clark oxygen sensing probe (Figure 8).

**Data and Analysis**

- The PtTFPP paint showed an increase in emission intensity at low oxygen levels when compared to high oxygen levels during a yeast-depletion study (Figure 5).

- Code written for the Arduino Uno® and Hamamatsu Digital Color Sensor, was used to control an LED and determine the percentage air saturation of a sample (Figures 6, and 7). Data was collected simultaneously by a Clark oxygen sensing probe (Figure 8).

**Data and Analysis Continued**

- A power law fit curve, comparing the percent air saturation values of the Clark sensor to the optical sensor, was applied using Excel (Figure 9).

**Discussion**

- The oxygen-sensing film containing PtTFPP, showed sensitivity to oxygen, with an increase in emission intensity corresponding to a decrease in oxygen in the sample (Figure 5).
- A successful code was written for an Arduino Uno® microcontroller, 405 nm LED, and Hamamatsu Digital Color Sensor, which allowed for the determination of the percentage oxygen in a sample.
- When a power-law fit curve was applied to the percentage air saturation between a Clark oxygen sensor and our optical sensor, the optical oxygen sensor showed excellent oxygen sensitivity.

**Literature Cited**


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