Developing an Oxygen Detection Device for a Microfluidic Hypoxia Chamber
Final Design Selection
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Final Design:

Metalloporphyrin-based thin-film sensor

Luminescent Material: PdOEPK

Encapsulation Matrix: Polystyrene

Thin-Film Sensor Design:

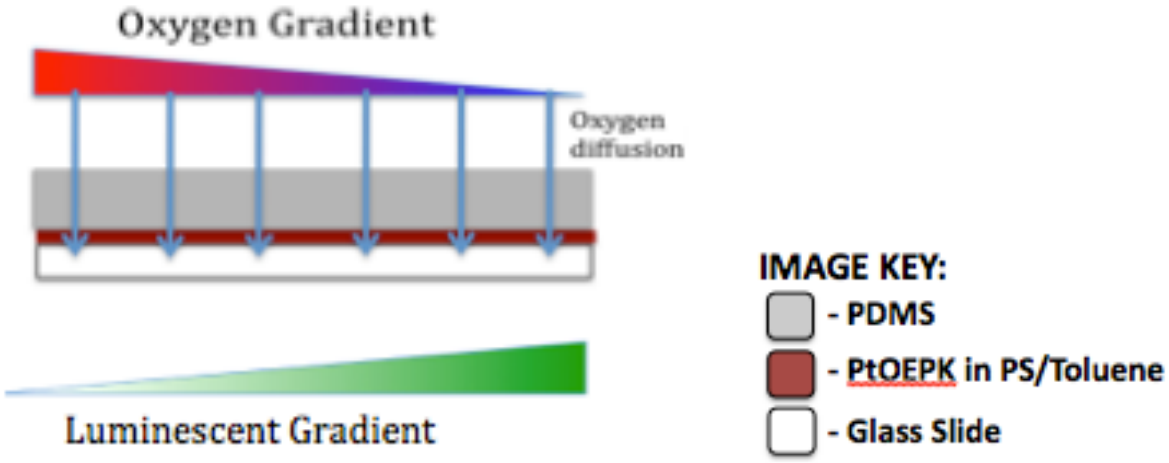


Figure 1. Slide view of thin-film sensor with microfluidic device.

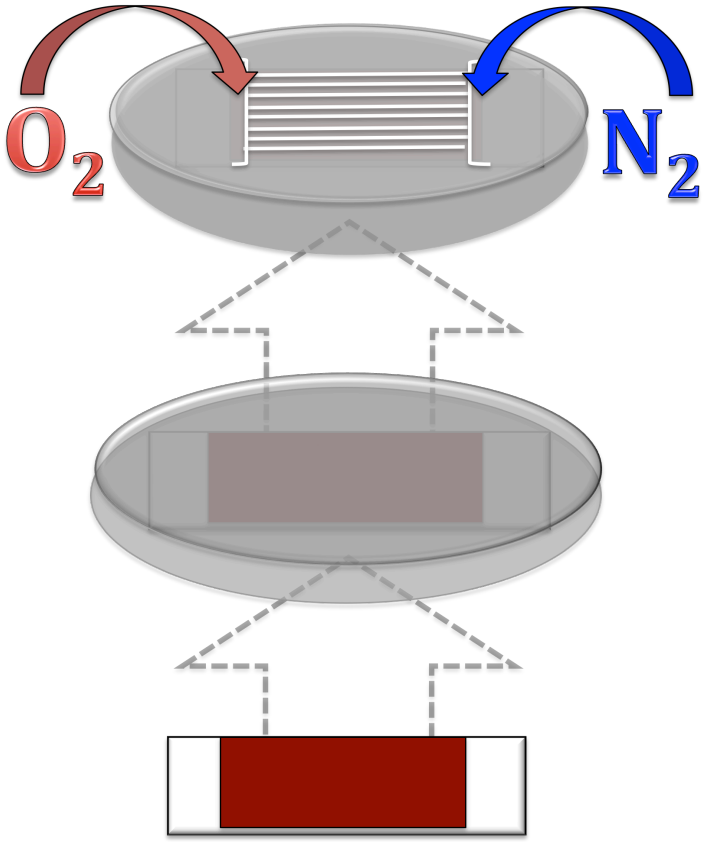
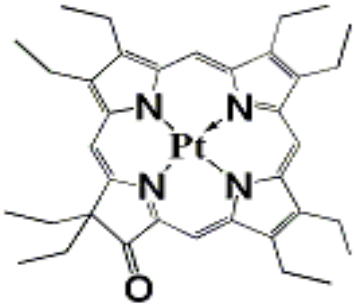


Figure 2. Thin-film oxygen sensor fabricated on a glass slide and placed beneath the microfluidic device for oxygen detection.

Background Information on Luminescent Material:

General Information:



Common name(s): PtOEPK

IUPAC name:	Platinum(II) octaethylporphyrinketone
Chemical Formula:	$C_{36}H_{44}N_4OPt$
Molecular Weight:	743.30 g/mol
Substance Class:	Metal-Ligand Complex

Spectra of

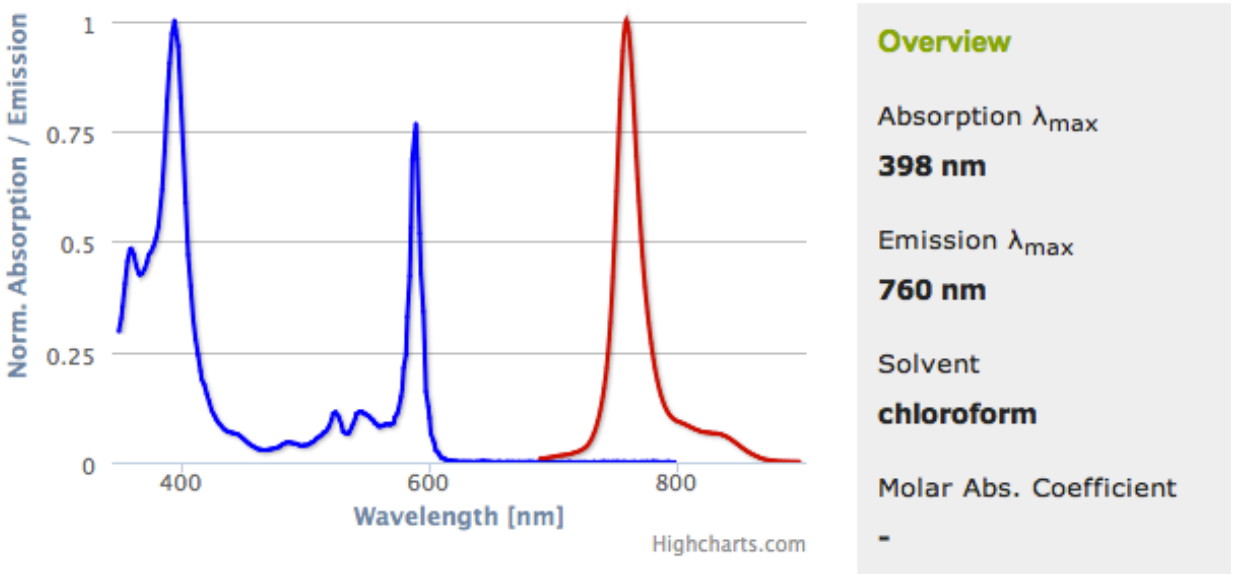


Figure 3. Absorption and emission spectra of PtOEPK. [1].

Compound Qualities

Indicator	Encapsulation Matrix	Unquenched Lifetime (μs)	Quantum Yield	Reported Sensitivity *	Excitation Peaks (nm)	Emission Peaks (nm)
PtOEPK	Polystyrene	61.4 at 22°C	0.12	High	398, 592	759
PtOEPK	PDMA	NR	NR	$Q_{DO} = 97.5\%$	NR	754
PdOEPK	Polystyrene	480 at 22°C	0.01	Very high	410, 602	790

Figure 4. Properties of luminescent material in various encapsulation matrices [2].

Setup for Intensity-bases Optical Oxygen Sensing

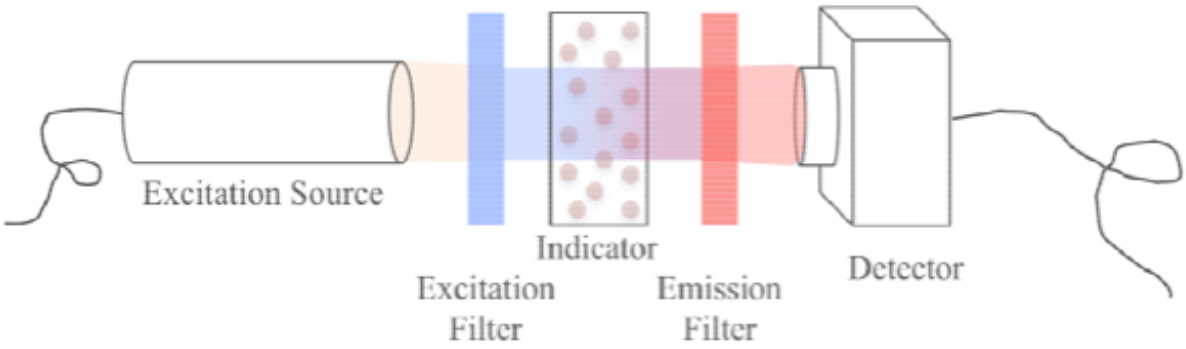


Figure 5. Simplified luminescent imaging system for oxygen sensing used for excitation of indicator material [2]

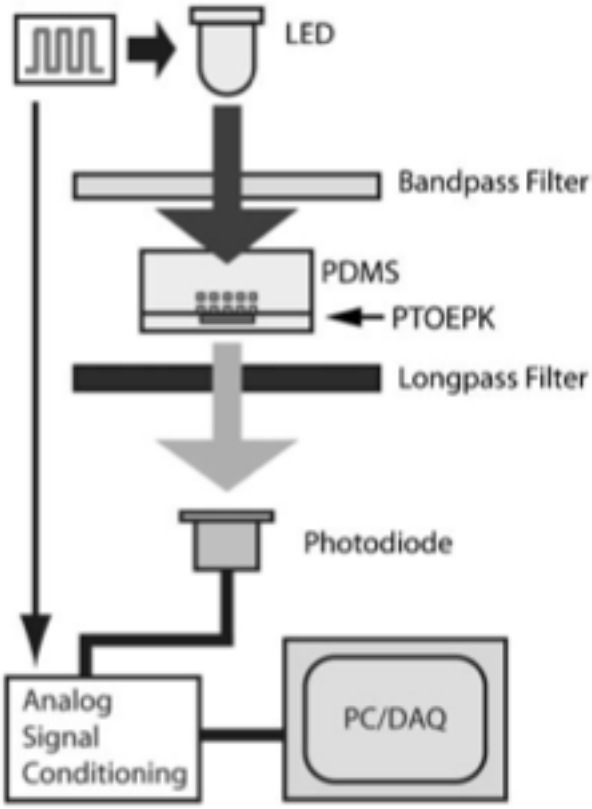


Figure 6. Optical and electrical components used in an excitation-detection system [3].

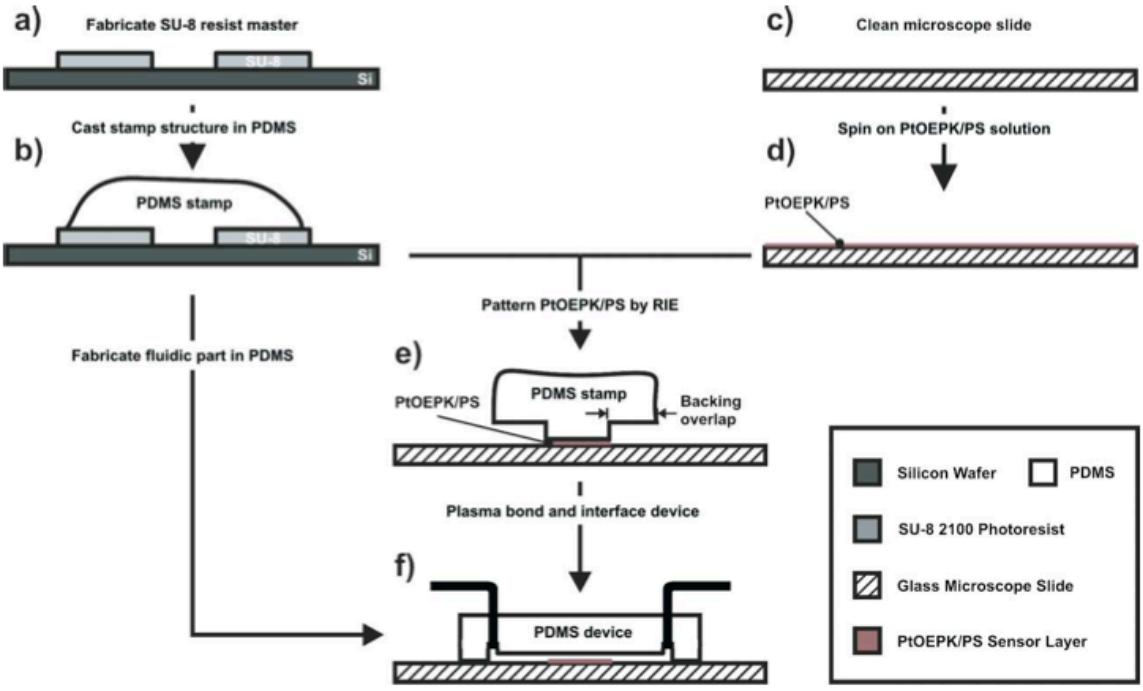


Figure 7. Schematic of the sensor fabrication process showing stamp fabrication in PDMS [4].

References:

[1] **http://www.fluorophores.tugraz.at/substance/633**

[2] Grist S.M., Chrostowski L., Cheung K.C. Optical Oxygen Sensors for Applications in Microfluidic Cell Culture. *Sensors*. 2010; 10(10):9286-9316.

[3] Vollmer, A.P.; Probstein, R.F.; Gilbert, R.; Thorsen, T. Development of an integrated microfluidic platform for dynamic oxygen sensing and delivery in a flowing medium. *Lab Chip* **2005,** *5,* 1059-1066.

[4] Nock V, Blaikie RJ, David T. Patterning, integration and characterisation of polymer optical oxygen sensors for microfluidic devices. Lab Chip. 2008;8:1300–1307. [PubMed]