# DISPOGEN—Oxygen Sensing at Home

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*Oxygen is one of the most often monitored parameters in research and industry. In the recent years, CSEM has developed a contactless optical sensing technology for oxygen monitoring in many applications such as respiration, 3D cell culture systems, beverage process control and water quality. CSEM is pushing the technology further with the release of cost-effective disposable oxygen sensors with a smartphone readout.*

Molecular oxygen is needed for aerobic life and, therefore, is one of the most monitored parameters in biotechnology, food production, industrial safety and pharmaceutical bioprocessing. In parallel, the demand for non-invasive, automated and wireless monitoring systems is growing to ensure product safety, quality and regulatory compliance.

Over the past years, CSEM has developed a new range of optical oxygen sensing systems including an objective-like reader for cell culture[1] and a fiber-based reader for incubators[2]. The sensors have shown advantages compared to current commercial solutions in particular in the reliability and robustness of the sensing layer. They are also more cost-effective. Wireless monitoring with standalone reader and mobile display is still an unreached market.

The project DISPOGEN builds on the expertise of CSEM in microelectronics, optics, and nanotechnology. The goal is to provide an innovative oxygen sensing solution, so called "O2@home", for domestic, technical and industrial applications (Figure 1). Oxygen concentration and sensor ID can be measured non-invasively through any transparent packaging or container.


*Figure 1: DISPOGEN's concept: a contactless and wireless system for oxygen sensing.*

CSEM oxygen sensor (patented technology) consists of a luminescent-reactive dye embedded in a hierarchical porous matrix. The production is compatible with industrial manufacturing processes. In addition, a matrix barcode can be printed for sensor identification and database (Figure 2).

These oxygen sensors are disposable and coupled with a portable reading device paired with a smartphone (Figure 3). This reader provides its light source (LED) and its detector (photodiode) and all the optoelectronic components for oxygen measurement. The system uses the camera of the smartphone to identify the matrix barcodes. Live oxygen readout and sensor ID are sent to the user's smartphone via Bluetooth and displayed on the screen via an Android application. The data are saved and stored in a distant database.

*Figure 2: Disposable oxygen sensor (1 x 2 cm) with a printed matrix barcode using a biocompatible ink.*

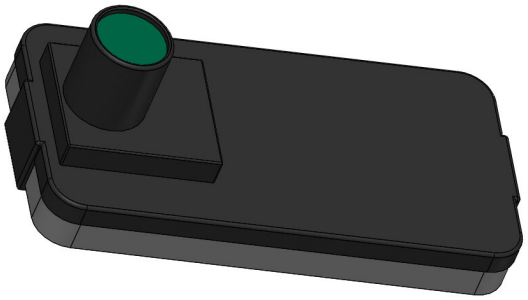

*Figure 3: The reading device is developed as an accessory for a 5.2" smartphone with an Android OS. It includes low consumption electronics, battery, proximity sensor, a photodiode, and Bluetooth communication.*

The DISPOGEN oxygen sensing solution fulfills all requirements for high precision, reliable, non-invasive, and wireless oxygen sensing. In this context, oxygen control can be used to assess e.g., microbial activity, quality of modified atmosphere to slow down the growth of aerobic microorganisms, dissolved oxygen in fishkeeping or prevent oxidation reactions. Besides, it enables applications requiring associated database management. This system also fits with the connected devices for home applications. It could be used to alert for oxygen depletion in a working room or in a private aquarium.

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[1] G. Weder, R. Ischer, M. Favre, R. Smajda, P. Albert, M. Liley, "DEMOX—a Miniature Non-invasive Optical Oxygen Sensor", CSEM Scientific and Technical Report (2015) 47.

[2] S. Heub, M. Jungo, R. Ischer, G. Weder, A. Grivel, R. Smajda, X. Bulliard, R. Pugin, M. Despont, "Non-invasive Measurement of Oxygen and Carbon Dioxide in Microscope Biochamber", CSEM Scientific and Technical Report (2017) 71.