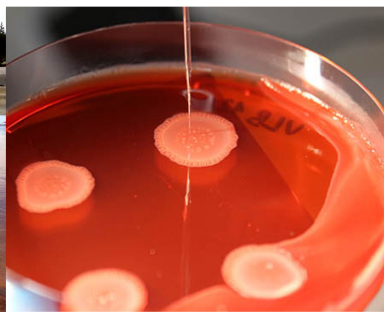
UNISENSE

ENABLING

MICROSCALE

RESEARCH



Unisense microsensors in biofilm research

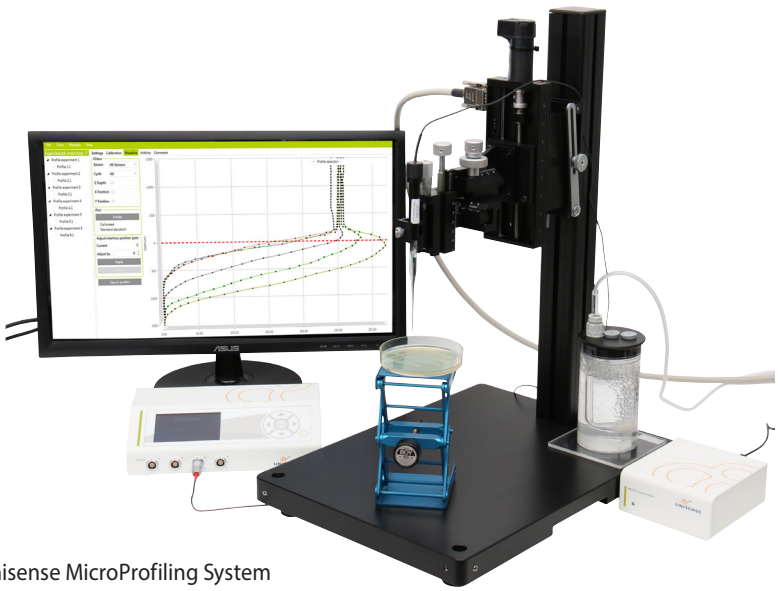
Real time monitoring of H_2S, O_2, NO, pH, Redox, H_2, N_2O or temperature in your biofilm

- Real time and true µm scale measurements
- In laboratory and in the field
- Non-destructive measurements
- Complete systems from sensors to software
- Study production and consumption of all analytes
- Interdisciplinary – biomedical, environmental and industrial

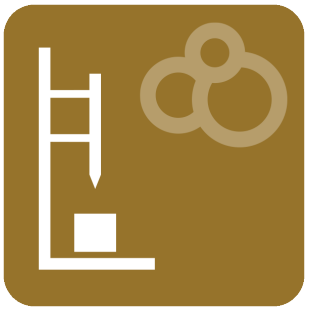
Take advantage of sensor tips with diameters less than 10 µm and complete real time measurements directly in your biofilm. Regardless of whether you measure oxygen availability in nitration biofilms, N_2O production in sputum, or maybe photosynthetic activity of microalgal biofilms, the Unisense microsensor technology will provide you with an accurate and reliable research tool.

Using the MicroProfiling System you can complete microprofiles with extreme positioning accuracy and high spatial resolution. The microprofiles can be performed manually operating the micromanipulator by hand, or automatically controlling a motorstage via your PC. The sensor signal is logged using SensorTrace Suite software, a software solution that also allows you to visualize and analyse your obtained data. The MicroProfiling System can be augmented with one or two more degrees of freedom, enabling you to conduct measurements in both two and three dimensions.

For research that requires measurement conducted in the field, we can also provide a solution that will allow you to conduct your research at remote locations without the need of human interaction once the equipment has been placed. The Field MicroProfiling System together with auxiliary equipment will allow the precise placement of the sensors and automated profiling. With this setup you can obtain a spatial resolution and accuracy of 10 µm in an in situ measurement.



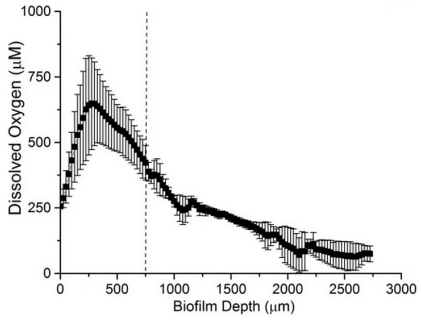
Unisense MicroProfiling System



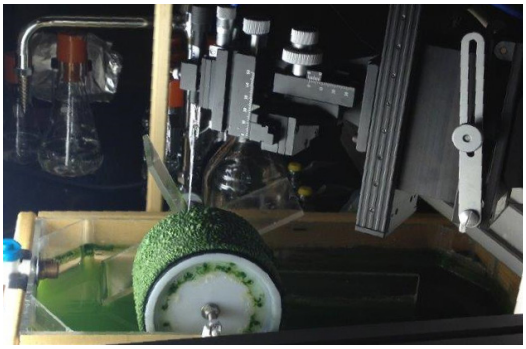
SensorTrace Profiling Software

Selected microsensor applications:

A



B



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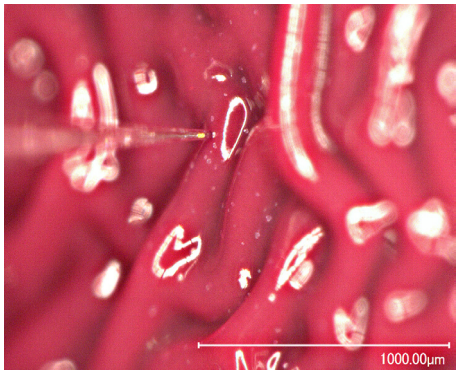

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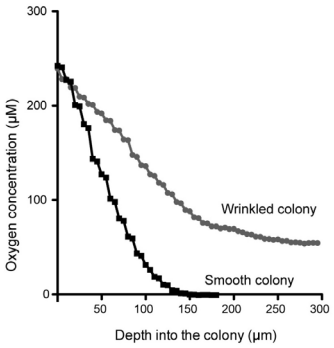
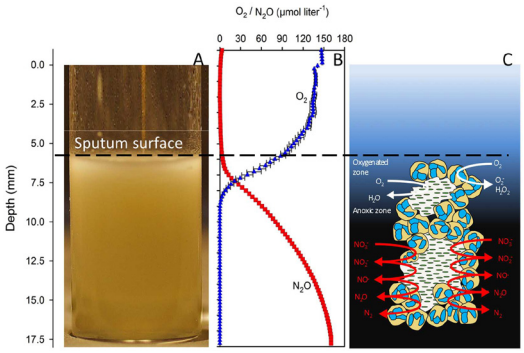


E



A & B) Oxygen profile down through algae biofilm and oxygen measure setup displaying the MicroProfiling System. Courtesy of Dr. R. Gardner and Dr. H.C. Bernstein, Montana State University and Pacific Northwest National Laboratory.
C & D) Unisense 10 µm sensor profiling into a P. aeruginosa colony and associated oxygen profiles. Courtesy of Dr. L. Dietrich, Columbia University.
E) A shows microsensor inserted into a sputum sample from a cystic fibrosis patient with chronic lung infection. B) O_2 microprofiles measured in the beginning of experiment and N_2O microprofile measured 6-7 h after the beginning. C) The metabolic mechanisms in the oxygenated and anoxic zones in the sputum sample. Figure adapted from Kolpen et al. 2014.

Selected papers in which Unisense microsensors are used for biofilm research:

Bernstein, H.C., Kesaano, M., Moll, K., Smith, T., Gerlach, R., Carlson, R.P., Miller, C.D., Peyton, B.M., Cooksey, K.E., Gardner, R.D., Sims, R.C., **Direct measurement and characterization of active photosynthesis zones inside wastewater remediating and biofuel producing microalgal biofilms**, Bioresource Technology 156, 206–215 (2014).

Jo et al. (2018) **An orphan cbb3-type cytochrome oxidase subunit supports Pdeudomonas aeruginosa biofilm growth and virulence**, eLife, Vol 6, p. 1-30.

Kempes C., Okegbe C., Mears-Clarke Z., Follows M., Dietrich L.E.P., **Morphological optimization for access to dual oxidants in biofilms**, Proceedings of the National Academy of Sciences of the United States of America 111(1):208-13 (2014).

Shanahan, J.W., Semmens, M.J., **Influence of a nitrifying biofilm on local oxygen fluxes across a micro-porous flat sheet membrane**, Journal of Membrane Science, Volume 277, Issues 1–2, 1 June, Pages 65–74 (2006).

Kolpen M., Kühl M., Bjarnsholt T., Moser C., Hansen C.R., **Nitrous Oxide Production in Sputum from Cystic Fibrosis Patients with Chronic Pseudomonas aeruginosa Lung Infection**. PLoS ONE 9(1): e84353 (2014).

Behrendt L., Larkum A.W., Trampe E., Norman A., Sørensen S.J., Kühl M., **Microbial diversity of biofilm communities in microniches associated with the didemnid ascidian Lissoclinum patella**, The ISME Journal 6, 1222–1237 (2012).