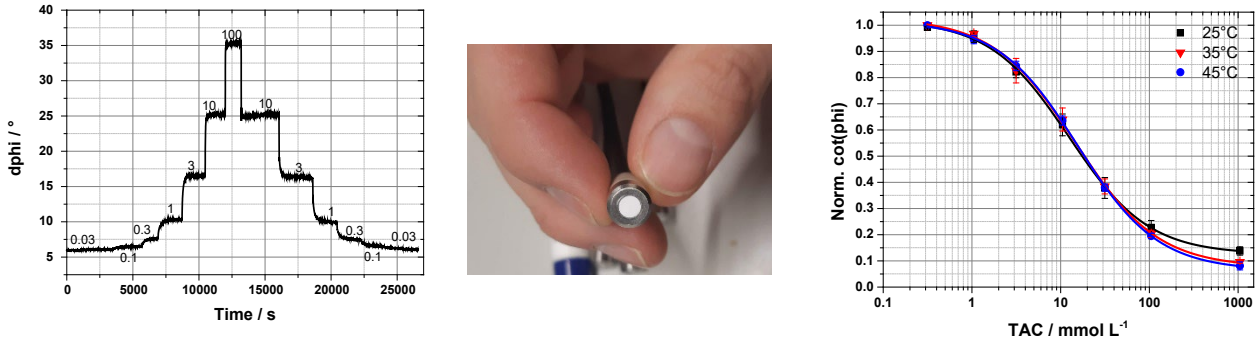
A FLUORESCENT OPTICAL AMMONIA SENSOR–SUITABLE FOR ONLINE BIOPROCESS MONITORING

Maximilian Maierhofer, Graz University of Technology, Austria
maierhofer@tugraz.at
Veronika Rieger, Graz University of Technology, Austria
Torsten Mayr, Graz University of Technology, Austria

Key Words: ammonia, bioprocess monitoring, optical sensor, toxicity, continuous

Optical sensors have found numerous applications in the last decades, e.g. optical sensors for oxygen and pH are established in bioprocess monitoring. In bio processing ammonia is another important analyte due to its toxicity at certain concentration levels.[1]. Since this compound is often a by-product in bioprocessing, online monitoring is desired. However, sensors for monitoring ammonia or ammonium in bioreactors are rare. We present a new ammonia sensor (Fig. 1 (b)) suitable for bioprocess monitoring. Our system is based on an acid-base concept including a fluorescent pH-sensitive dye.[2] The sensing layer is covered by a hydrophobic porous membrane, which excludes hydrophilic interfering materials. Our target analyte, ammonia (NH_3), diffuses through the barrier to the protonated dye whereby it deprotonates the dye and switches off the NIR-emission. Read-out is performed with a commercially available compact phase fluorimeter combined with optical fibers. Dual-lifetime referencing (DLR) acts as detection method and Egyptian blue as reference material. A sensor performance in the range of total ammonia concentration (TAC, NH_3 + NH_4^+) from 1 to 100 mmol L^{-1} is demanded. Depending on temperature and ammonia concentration the response time t_{90} and the recovery time vary from 20 s up to 4 min (Fig 1 (a)). The sensor performance is not influenced sufficiently by increasing temperature (Fig. 1 (c)).

The sensor materials are chosen to withstand β-sterilization. Further experiments on other sterilization methods will be studied in future. This sensor is planned to monitor reactions in bioreactor systems.



(a) **(b)** **(c)**

Figure 1 (a) Sensor response at 25°C at seven different ammonia concentrations in mg L-1 (b) Optical ammonia sensor attached to an optical fiber with a stainless screw-cap, diameter 5 mm; (c) Calibration plots of ammonia sensor monitored at three different temperatures for TAC in mmol L-1. Mean values and standard deviations obtained from four sensors.

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