

# PHENOL DERIVATIVE BASED CARBON DIOXIDE SENSOR FOR ENVIRONMENTAL MONITORING

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Fiber optic arrangements are widely used when distributed sensing is necessary; especially when the distance between the sensor tip and the measurement unit should be large. If the sensor's response is based on interferometric phenomena in the near infrared the optical signal could be read out several kilometers far from the chemically sensitive layer using standard telecom technology. In this work a novel optical-fiber sensor is presented for measuring gaseous and dissolved CO<sub>2</sub> for environmental monitoring, where the optical signal is based either on refractive index changes or on color change<sup>[1][2][3][4]</sup>.

The sensing chemistry is based on the acid-basic equilibrium of 4-nitrophenol (pNP), that is converted into the anionic form by addition of a quaternary ammonium hydroxide<sup>[5]</sup> and immobilized into a polyurethane hydrogel matrix<sup>[6]</sup>. pNP is a well-known colorimetric indicator for titrations having a pKa value around 7.2 making it suitable for CO<sub>2</sub> sensing. On the other hand it was assumed that the rearrangement of its electron system during protonation/deprotonation resulted also in refractive index changes, large enough to get sufficient signal when the indicator is embedded into a polymeric matrix. For the measuring of dissolved CO<sub>2</sub> the sensing layer was covered additionally by a hydrophobic silicon rubber layer to prevent the ion-exchange between the sensor layer and the sample.

The CO<sub>2</sub> sensitive layer is characterized and tested by using simple absorbance/reflectance measurement setup where the sensor (placed in a flow through cell) was connected to a fiber optic photometer, and also by using different refractometric fiber optic sensor configurations. Since the refractive index of the polymeric matrix is not changing, one important task was to select the proper indicator/polymers ratio. Among the common sensor properties, such as response time, dynamic range, detection limit, etc., the effect of the amount of the quaternary ammonium compound and the thickness of the silicone layer on the refractive index changes were also measured and discussed.

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