Novel, Low-Cost, Side-Illuminated, Multi-Point Optical Fiber Sensor

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WHAT IS AN OPTICAL FIBER?

• An optical fiber is a light “pipe”.

• By the same token that a light pipe can guide *water* from one end of the pipe to another, an optical fiber can guide light from one of its end to the other as well.

• Light can be affected by the outside medium surrounding the fiber and the effect in the light can be used to infer what is happening outside the fiber.
# FIBER SENSORS BEFORE 2006

<table>
<thead>
<tr>
<th>Fluorescent</th>
<th>Absorption</th>
<th>Scattering</th>
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<tbody>
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<td><img src="image1.png" alt="Fluorescent Diagram" /></td>
<td><img src="image2.png" alt="Absorption Diagram" /></td>
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<td><img src="image4.png" alt="Fluorescent Diagram" /></td>
<td><img src="image5.png" alt="Absorption Diagram" /></td>
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<td><img src="image7.png" alt="Fluorescent Diagram" /></td>
<td><img src="image8.png" alt="Absorption Diagram" /></td>
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Fiber is coated with a fluorescent film sensitive to the targeted parameter
SIDE ILLUMINATED FIBER

• Distributed/multi point sensing easily accomplished.

• Can detect more than one parameter.

• High spatial resolution at low cost.

• High signal output.

• Simpler detection system.

• Can be adapted to handle almost any optical sensing configuration (fluorescence, absorption and scattering).
SIDE ILLUMINATION
DISTRIBUTED SENSING
SIDE ILLUMINATION
DISTRIBUTED SENSING
Confidence level is higher than 99% due to value of $R$. 

CHLORIDE ION SENSOR 
CALIBRATION IN NaCl SOLUTION
### TYPES OF FIBER SENSORS

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Resolution of 0.21% in RH.
## TYPES OF SIDE ILLUMINATED SENSORS

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<tr>
<td><strong>1980’s</strong></td>
<td><strong>2006</strong></td>
<td><strong>N/A</strong></td>
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<tr>
<td>Chloride ions</td>
<td>Relative Humidity</td>
<td></td>
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<td><strong>2010</strong></td>
<td><strong>2008</strong></td>
<td><strong>2008</strong></td>
</tr>
<tr>
<td>Chlorophyll</td>
<td>Nitrate</td>
<td>Turbidity</td>
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**2008**
NITRATE SENSOR

Visible and UV Absorption.
NITRATE SENSOR
COLORIMETRIC APPROACH

\[ y = -2.3201x + 742.2 \]
\[ R^2 = 0.9738 \ (T=10.8^0C) \]
NITRATE SENSOR
UV ABSORPTION APPROACH

![Graph showing the relationship between intensity and [N-NO₃] (ppm). The equation is y = -0.1942x + 1071.5 with R² = 0.9376.](image)
LIQUID LEVEL SENSOR
ACKNOWLEDGEMENTS

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