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Content

This NewsLetter is dedicated biosensors, and their use for e.g. reduction of pesticides by quantification of plant diseases and pests in the field.

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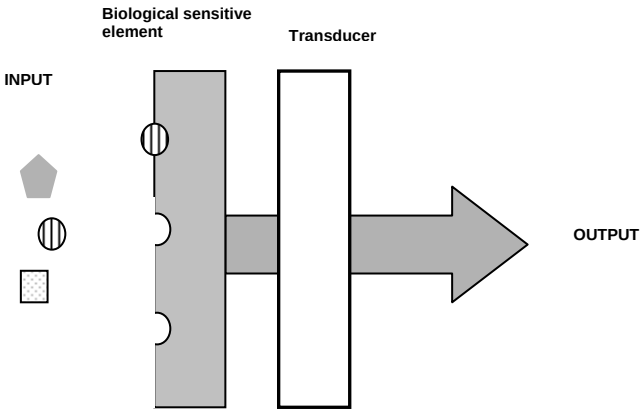
Biosensor

A biosensor can be described as a device that detects, records, and transmits information regarding a physiological change or process using biological materials to monitor the presence of various chemicals in a substance (e.g. air).

It consists of:

- The **sensitive biological element** (biological material, *e.g.* tissue, micro organisms, organelles, cell receptors, enzymes, antibodies, nucleic acids etc., a biologically derived material or biomimic)
- The **transducer** converts the interaction between the biological sensor layer and the analyte to a measurable output which can be optical, mass, electrochemical or thermal.



When using specific biological receptors for example antibodies, binding proteins or specific oligo-nucleotides as binding domain, it is possible to generate a very specific sensor with a very high specificity for its target molecule

Biosensors in the future

Biosensors have major applications in medicine, food and processing industry and environmental diagnostics. Their excellent target specificity and convenient signal production are a perfect combination for analyte detection. They are able to utilize specific biological receptors, and as there are millions of different biological molecules which bind to specific proteins or binding molecules their applications are unlimited. The use of small sensors makes it possible to gather data from e.g. animals, plants and production facilities in a fast, efficient and cheap way giving rise to new systems of organisation and decision management. In agriculture sensors will be able to help optimize production and animal welfare through e.g. optimal nutrition and protection strategies.

Biosensor project

An example of the use of biosensors is the project "Reduction of pesticide use by quantification of plant diseases and pests in the field using biosensors". The aim of this project under DaNet is to develop chemical sensors or biosensors, which can detect and quantify specific plant diseases and pests. These sensors could be mounted on platforms such as the API (Autonomous Platform and Information system) for registration of diseases and pests in the crop. This information would enable a reduction in the use of pesticides by precise and targeted application.

Two model organisms have been chosen to test the feasibility of the sensor concept: wheat yellow rust (*Puccinia striiformis)* has been chosen as a model organism for a fungal disease, and bird cherry-oat aphid (*Rhopalosiphum pad*) in spring barley as a model for a pest. Both organisms are potentially some of the most damaging diseases and pests in Denmark. Two different sensor systems will be developed: an immunosensor for the fungal disease and a gas sensor for the aphids. The immunosensor is based on piezoelectric quartz crystal microbalance (QCM sensor) or surface plasmon resonance (SPR sensor), and for the gas sensor QCM is being tested.

The immunosensor measures the amount of fungal spores in the air by binding of an antigen in the spores to specific antibodies. The binding of the antigen to the antibodies changes the mass on the sensor surface and results in an electrical signal. It is possible to make the biosensor for wheat yellow rust operational on a laboratory scale. The challenge is to develop and test the sensors for optimal response, and make the system stabile and calibrate it, so that it can be used in the field, that is real-time and on-site.

The development of a gas sensor for detection of aphids is still on a very experimental level with preliminary trials being conducted over the summer 2005. For further information about the project following references are available: DaNet homepage
Article: "Early warning 'air defence' system"

Figure: The two model organisms in the biosensor project: In the top; wheat yellow rust as a model organism for a fungal disease, and in the bottom; bird cherry-oat aphid in spring barley as a model for a pest (Photos kindly contributed by Henny Bodil Rasmussen and Lars Monrad Hansen, DIAS).

Topics of coming newsletters

Automatic and manual technology for early identification of production diseases
Intelligent Sensor for Autonomous Cleaning in livestock buildings
Robotics in agriculture