



1/2 *Sensor pigments*

SENSOR TEXTILES FOR IMPROVED SAFETY

Applications

Staff in laboratories, chemical industry or semiconductor production come to contact with hazardous substances every day as a part of their daily routine work.

Integration of indicator dyes into textiles enables new forms of effective occupational safety. Protective clothing equipped with sensors, which change their color at contamination by certain hazardous substances, can inform the laboratory employees on the potential danger in a quick and simple manner.

Potential fields of application for sensor dyes in textiles also include:

- Wound healing control
- Early detection of diseases
- Environmental monitoring

Benefits of the novel sensor dyes

Optimal security

- Detection and indication of hazardous substances directly at the source of contamination

Inexpensive production:

- Manufacturing of the sensor textiles can be carried out using the conventional textile manufacturing processes

Simple usability

- No need for additional infrastructure (e.g. electricity) or equipment for processing the sensor signals

Reusability:

- Sensor textiles can be reused after the contamination, e.g. after washing them

Fraunhofer Research Institution for Microsystems and Solid State Technologies EMFT

Hansastraße 27 d
80686 München
Phone: +49 89 54 75 90
Fax: +49 89 54 75 95 50
E-Mail: contact@emft.fraunhofer.de

Project Manager:
Dr. Sabine Trupp
Sabine.Trupp@emft.fraunhofer.de

www.emft.fraunhofer.de



Technological innovation

Fraunhofer EMFT develops custom-made indicator dyes, adapted to specific customer requirements. Suitable indicators can be produced for a variety of hazardous substances, such as toxic, corroding or irritating materials. The sensor dyes can be fixed on yarns, fabrics and confectioned textiles using standard methods for dyeing, printing and coating. Confectioned textiles can also be coated with sensor particles. For this purpose the indicator dyes are integrated in commercially available pigments, or completely new sensor pigments are synthesized.

Indicator dyes and sensor pigments

The indicator dyes and sensor pigments developed at Fraunhofer EMFT are able to detect such analytes as CO, CO₂, O₂, NO, NH₃, amines, aldehydes, or saccharides, and indicate their presence by change in color or fluorescence. Properties like sensitivity, selectivity and reversibility of the indicator reaction, are customized for the specific application during the synthesis.

Design of sensor pigments

Sensor pigments can be assembled in various ways. An indicator dye can simply be integrated into the particle matrix, or core-shell systems can be used, where the core assumes a different function than the shell. An example of such a system is a fluorescent nanosensor carrying a reference dye in its core and an indicator dye in its shell or surface, thus enabling ratiometric fluorescence measurements (see Fig. below). Multilayer systems are possible as well. Characteristics such as size (in nano- to micrometer scale) or surface polarity can be influenced by specific synthesis of the particles.



Perspective

Miniaturized sensor modules integrated into textiles offer further advantages: Besides detecting the hazardous substances, the measured data could also be stored and transmitted to a central control unit for evaluation. This enables longer-term documentation of how frequently the person in question was exposed to the hazardous substance and how high the respective concentration was.

3 Indicator dyes in solution

4 Protective glove warning of hazardous substances by color change