

## H<sub>2</sub>S and temperature sensors

### Introduction

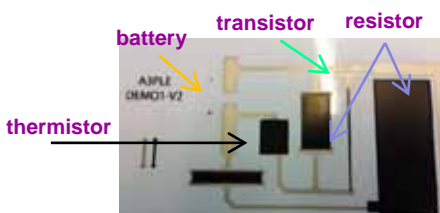
A3ple creates printed autonomous electrically responsive sensor labels on paper. In A3ple, 3 demonstrators are developed that can be used to determine presence of H<sub>2</sub>S, CO and temperature differences. In this newsletter the H<sub>2</sub>S and temperature sensor, developed at TNO, are discussed.

### Objectives

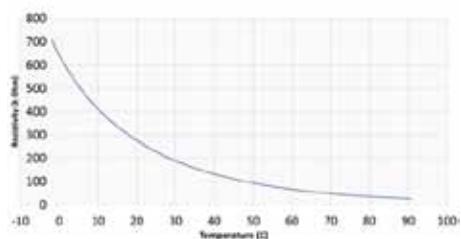
- The gas sensor should distinguish poisonous H<sub>2</sub>S gas (< 2 ppm) for safety applications.
- Printed temperature sensors with a temperature coefficient ( $\alpha$ ) above 3 %K<sup>-1</sup>, able to be integrated in the demonstrators

### Printed temperature sensor (thermistor)

The temperature sensor exists of a printed track and a (semi) conductive material, in which the resistance is depending on the temperature. The temperature coefficient ( $\alpha$ ) and the relative resistivity ( $r$ ) of the printed sensors are the determining factors for the sensitivity and usage of the temperature sensor. In A3ple it was chosen to use a NTC material as temperature sensor.



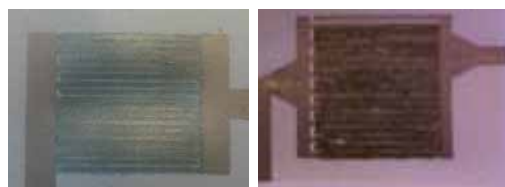
Flexo gravure print on paper @partner Labeltech



Typical result of thermistor Temperature coefficient:  $\alpha (T=25^{\circ}\text{C}) = -3,8\%K^{-1}$

### Printed H<sub>2</sub>S sensor

The sensor will typically be used for measuring H<sub>2</sub>S levels in safety applications where H<sub>2</sub>S can be expected, such as industrial environment, food and oil platforms.



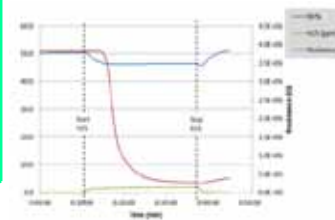
Color change after exposure

Before

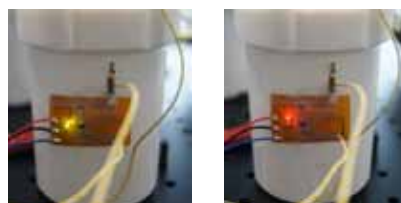
after exposure to H<sub>2</sub>S



Gas Exposure box for H<sub>2</sub>S subjection



Typical result: Resistance drop



Electric signalling of H<sub>2</sub>S

**Conclusion:** In the A3ple project TNO developed a H<sub>2</sub>S and Temperature sensor. The active material in the H<sub>2</sub>S sensor was inkjet printed on the paper substrate. The thermistor was synthesized at TNO and stencil printed on paper. In the near future the sensors will be deposited by flexo gravure printing.

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