

1. Introduction

Phthalocyanines (porphyrine derivatives, Pcs) belong to a group of compounds which are reasonably utilized in **gas/liquid analysis**, because the interaction with a variety of different compounds (NO_x , Cl_2 , O_3 , H_2S , NH_3 , VOCs, ...) results in significant **change of resistance**.^{1,2}

The **aim of diploma thesis** was twofold:

1. to achieve effective **adjustment of electrical resistance** with nanostructuring,
2. to **enable detection of markers of explosives** with chemiresistors based on Pcs.

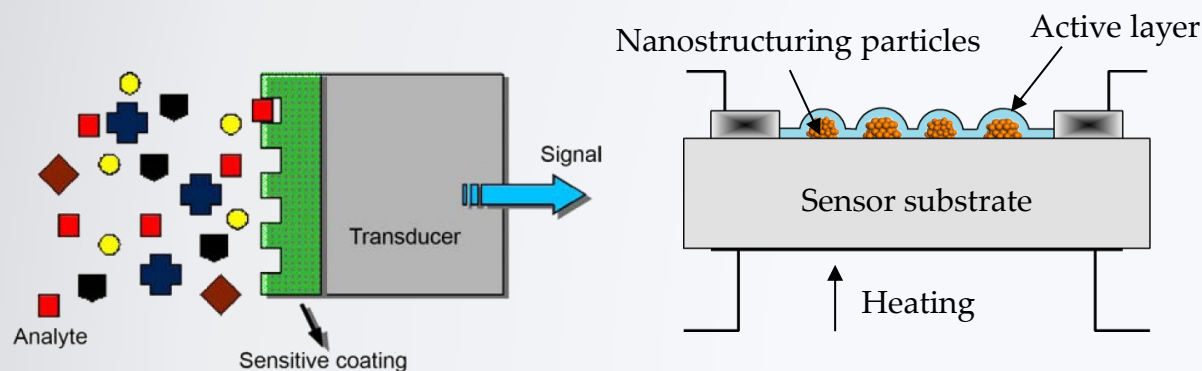


Fig. 1: General sensor scheme.³

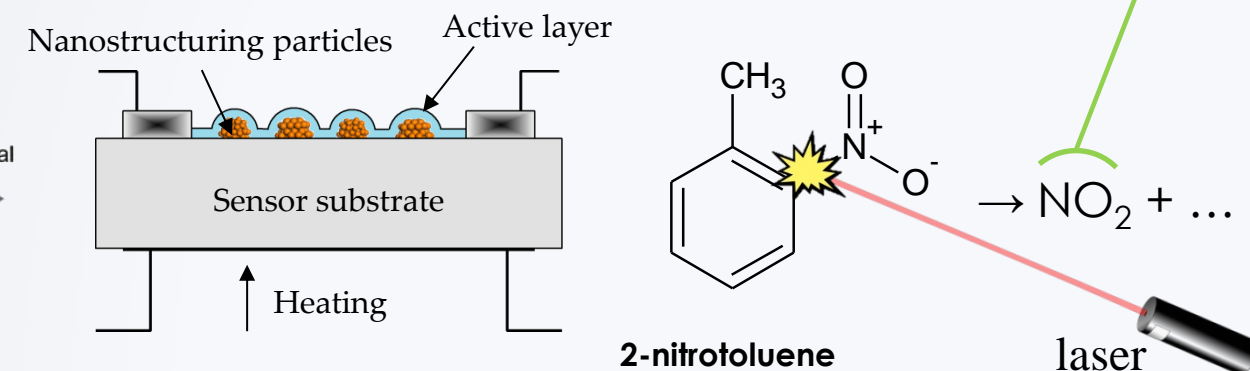


Fig. 2: Cross-section sensor structure. **Fig. 3:** Indirect detection of taggants.

2. Experimental

Metallic nanostructures (Au, Pd) on the alumina surface were prepared by **DC magnetron sputtering** and **in-situ annealing**. Formation of metallic nanoparticles was inspected using scanning electron microscopy and continual resistance measurements.

Silver phthalocyanine active layers were prepared by **Organic Molecular Evaporation (OME)** method under high vacuum conditions. The thickness was measured with Quartz Crystal Microbalance (QCM). Vapours of taggants were exposed to UV light generated in a **Nd-YAG laser**.

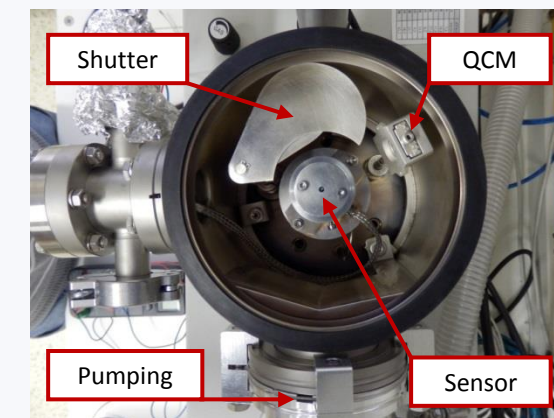


Fig. 5: Sputtering chamber.

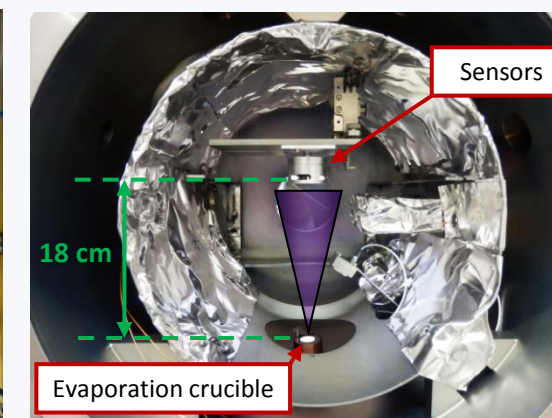


Fig. 6: OME apparatus.

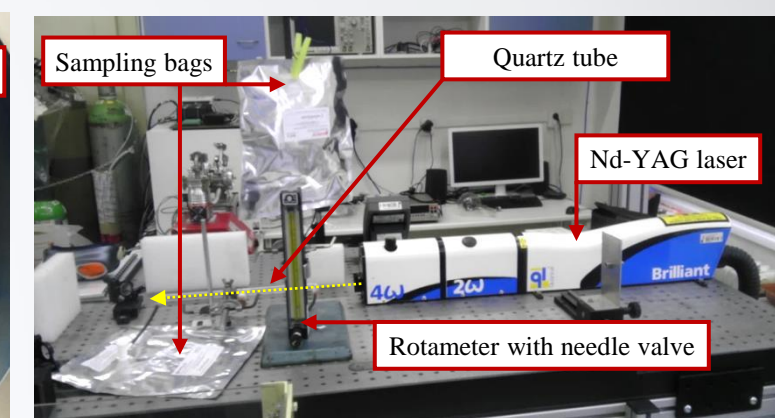


Fig. 7: Laser exposition apparatus.

a) Surface morphology

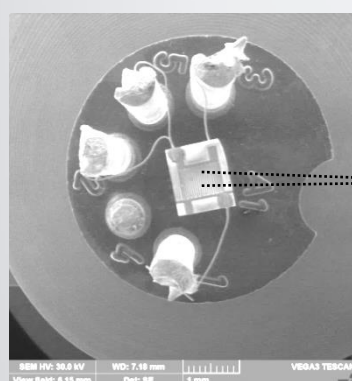


Fig. 8: Sensor structure.

3. Results

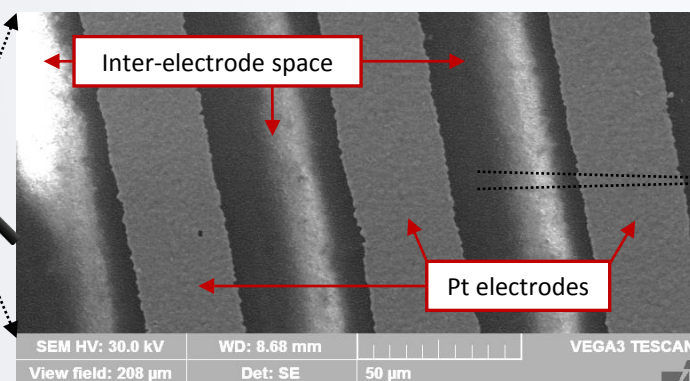


Fig. 9: Interdigital platinum electrodes.

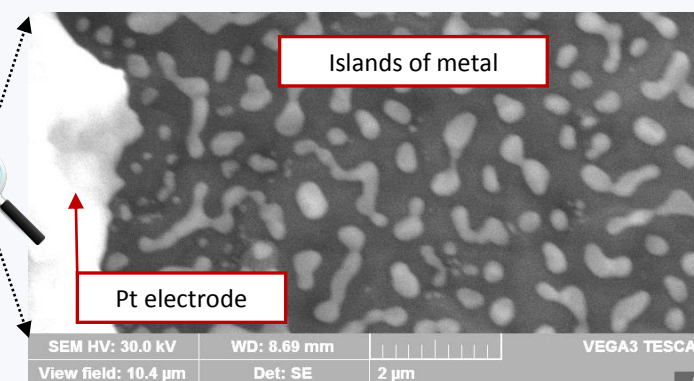
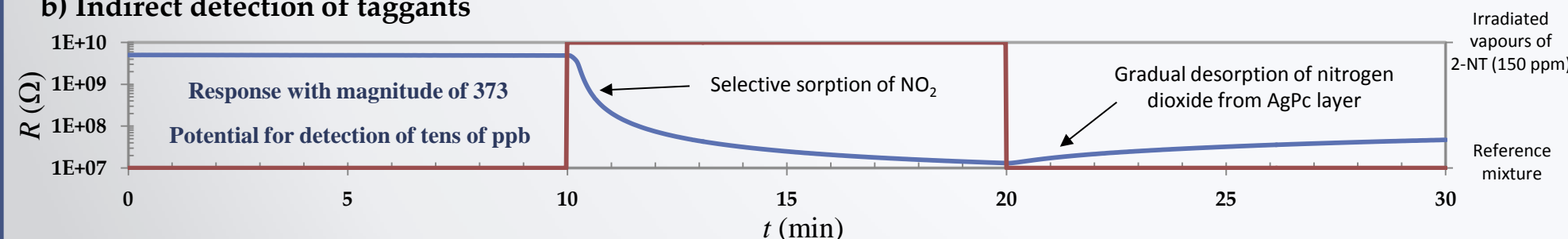


Fig. 10: Nanostructuring metallic islands.

b) Indirect detection of taggants



4. Conclusions

To conclude, this contribution employs photo-induced decomposition of nitro compounds for their indirect **detection by means of NO_2 sensors**. The created methodology has a potential to detect nitro compounds which are used as **markers of explosives** (2-nitrotoluene, 4-nitrotoluene, 2,4-dinitrotoluene, 2,3-dimethyl-2,3-dinitrobutane, ...) in concentrations as low as **tens of ppb**. Application of NO_2 sensors instead of expensive analytical equipment (ion mobility spectrometers, gas chromatographs ...) promises **significant cost savings in detections of explosives**.

Moreover, metal nanoparticles are used to **decrease electrical resistance** (up to 100x) of sensors based on phthalocyanines. This reduces the requirements for the level of attached ohmmeter device and as a result it contributes to another **reduction of costs**.

5. References

1. P. Fitl, M. Vrnata, D. Kopecky, J. Vlcek, J. Skodova, J. Bulir, M. Novotny and P. Pokorny, *Applied Surface Science*, 2014, **302**, 37-41
2. R. Zhou, F. Josse, W. Gopel, Z. Z. Ozturk and O. Bekaroglu, *Appl Organomet Chem*, 1996, **10**, 557-577.
3. Z. Z. Öztürk, N. Kılınç, D. Atilla, A. G. Gürek and V. Ahsen, *J Porphyr Phthalocya*, 2009, **13**, 1179-1187.

