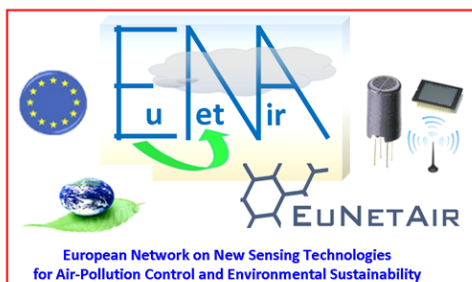


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BOOKLET

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APPLICATION OF CHEMIRESENSITIVE POLYMER FILMS IN AIR QUALITY CONTROL

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History of application conductive polymers or polymer composites in gas sensing is not long time ago. Okazaki in 1999 reported about determined polymer-carbon nanoparticle composite electrical resistance change in presence of VOC [1]. Since that time a lot of research has been done to investigate: *i*) VOC sensitivity of different compositions varying conductive fillers and polymers; *ii*) the sensing mechanism and experimentally prove it; *iii*) cross-sensitivity and selectivity. However, long term stability of polymer based gas sensors is an issue, which demands improvement.

Nowadays importance of air quality control is even increased, because people daily habits are changed and more time is spent indoors or urbanised territories. In today's perspective chemiresistive polymer films (CPF) as a tool for air quality control is highly attractive and I will explain why. Comparing to other sensing devices CPF are selective. It means that composite response to different VOC like toluene, benzene, ethyl acetate, acetone and etc. deviates [2-4]. Zeng W. even describes possibility to distinguish VOC by the molecule size [3]. Results obtained at lab show that CPF are sensitive enough - concentrations greatly below VOC regulated exposure limits can be sensed, for example, toluene 10-15 ppm was detected by composite made of thiophene based conducting polymer and carbon black nanoparticles [5]. CPF operate at room temperature, therefore low power air quality control devices can be made. Cost of CPF based sensing element is low and has potential to be easily mass-produced by printing [6].

Composite sensing mechanism of gases determines which gases could be detected by certain composition. Best results for non-conductive polymer composites are obtained when these composites are applied for VOC detection. Data available in literature evidence that conductive polymer nanocomposites, for example, polyaniline(PANI)-Ag nanocomposite, PANI-single wall carbon nanotubes composite or PANI-metal salt (CuCl₂) are more preferable for inorganic gas detection like SO₂, CO₂, H₂S and NH₃. Promising sensing results have been reported in literature for conductive polymer nanocomposites reaching 1 ppm detection limit of inorganic gases. According to OSHA data time weighted average (TWA) for SO₂ - 2 ppm, CO₂ - 5000 ppm, H₂S - 10 ppm and NH₃ - 50 ppm.

References

1. Okazaki M., Shirai Y., Maruyama K., Tsubokawa N., "A novel gas sensor from crystalline polymer-grafted carbon black: responsibility of electric resistance of composite from crystalline polymer-grafted carbon black against solvent vapour", *Polymer Bulletin* **42** (1999) 425-431.
2. Chen S.G., Hu J.W., Zhang M.Q., Rong M.Z., "Effects of temperature and vapor pressure on the gas sensing behavior of carbon black filled polyurethane composites", *Sensors and Actuators B* **105** (2005) 187-193.
3. Zeng W., Zhang M., Rong M., Zheng Q., "Conductive polymer composites as gas sensors with size-related molecular discrimination capability", *Sensors and Actuators B* **124** (2007) 118-126.
4. Knite M., Ozols K., Sakale G., Teteris V., "Polyisoprene and high structure carbon nanoparticle composite for sensing organic solvent vapours", *Sensors and Actuators B* **126** (2007) 209-213.
5. Ashwini N. Mallya, Ranjith Kottokaran, Praveen C., "Ramamurthy Conducting polymer-carbon black nanocomposite sensor for volatile organic compounds and correlating sensor response by molecular dynamics", *Sensors and Actuators B* **201** (2014) 308-320.
6. J. Sarfraz, P. Ihalainen, A. Määttä, J. Peltonen, M. Lindén, "Printed hydrogen sulfide gas sensor on paper substrate based on polyaniline composite", *Thin Solid Films* **534** (2013) 621-628.