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High sensing potentialities of tetra-tert-butyl-metallophthalocyanines-based acoustic microsensors for xylenes measurement in air at room temperature.

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Abstract:

Xylenes, classified as Volatil Organic Compounds, is a very harmful pollutant for human health that can be absorbed into the body via all exposures routes: inhalation, ingestion, or dermal. As defined by the US Environmental Protection Agency, the occupational exposure limits are set to 100 ppm while the guidelines in non-occupational context are fixed to 50 ppm. For the concentration measurements in the atmosphere, authorities commonly used sampling methods with post-exposure chemical titration or chromatography. A strong interest remains on the development of low cost, low power consumption and easy implemented microsensors able to deliver real-time indicative measurements in the ppm concentration range.

Most of microsensors aimed to the quantification of xylene concentration in air implement doped MOx [1,2], MOx nanocomposites [3,4] or Metallic Oxide Frameworks [5]. Despite their suitability for xylene detection into the ppm concentration range, the main drawback remains the high required operating temperature (>250 °C). During this lecture, the high potentialities of acoustic microsensors with tetra-tert-butyl metallophthalocyanine as sensing materials for xylene monitoring will be highlighted. If neither the nature of the metallic layer used as an electrode on quartz, nor the nature of the central metal atom in the phthalocyanine macrocycle have no impact on the sensor responses, the sensing enhancement provided by butyl groups is established. Experimental results revealed that ttb-CuPc based QCM sensors are suitable for accurate measurements of xylene concentration from 50 to 500 ppm, without any hysteresis effect, at room temperature. The response and recovery times were assessed close to 3min, while the LOD to a few ppm, and a good repeatability is manifest. The cross-sensitivities were determined towards various VOCs and NO₂, with higher responses obtained for xylenes (Fig.1). The influence of relative humidity of gas mixture on response was investigated and will be discussed.

Keywords: Substituted phthalocyanines, Organic semi-conductor, Quartz Crystal Microbalance, acoustic sensors, Xylenes, Volatiles Organic Compounds, gas microsensors, pollutant monitoring.

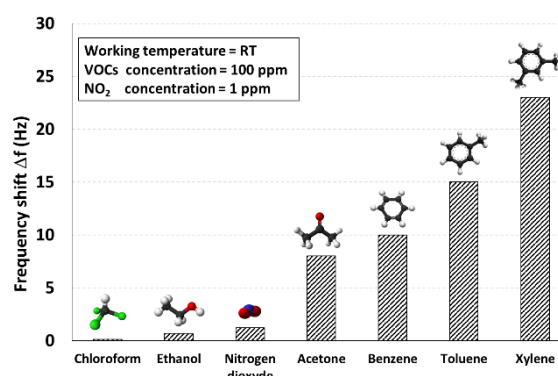


Figure 1: Intercomparison of ttb-CuPc-based QCM responses towards NO₂ and Volatils Organic Compounds at room temperature. The stabilized responses were obtained after 3 minutes of pollutant exposure and a temperature drift compensation was applied to each measured frequency.

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