Formaldehyde detection for indoor air quality

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Volatile Organic Compounds in indoor air have become these last years the subject of a big concern. The main emission sources are: furniture, paintings, varnishes, wood protection, construction materials, etc. In particular, formaldehyde is now considered by the authorities as one of the priority pollutants because of its carcinogenic [1] character and because of the multiplication of sources in our close environment. The World Health Organization (WHO) guideline for indoor air formaldehyde concentration is 80 ppb (0.1 mg/m3) [2]. Methods based on air sample collection and lab measurements are available and are the most used methods [3]. They are accurate and reliable but these methods are expensive, are not real time and some statistics issues are raised because of that. That is why, it is important to detect and measure formaldehyde in real time, in situ and with a low cost equipment. Devices based on chemical sensors are a good solution as these systems can be ve ry sensitive, low cost and easily integrated in common electronics to build portable systems [4]. Different sensing technologies exist and we will focus on electrochemical systems exploiting organic or inorganic semiconductor materials. These sensors are based on the monitoring of the conductivity changes of a semiconducting sensitive coating due to a reversible doping by the adsorbed gases. This paper will shortly present a overview of the existing sensors for formaldehyde detection and new sensors based on metal oxides and on the use of molecularly imprinted polymers. Metal oxide gas sensors are well known for their high sensitivity allowing detection in the ppb concentration range and their stability. The main drawback is that they generally need to be heated to temperatures in the range 150-350°C. In order to reduce the power consumption, the area of the sensitive layer is miniaturized using MEMS technology. Our sensor with an area of 200x200 μm2 consumes a power of 15mW when it operates continuously. The concentration range for formaldehyde is 10-2000 ppb. Molecularly imprinted polymers (MIP) are polymers that are synthesized incorporating the target molecule we want to detect as a template. Functional monomers form a complex around the template and are linked afterwards to form a polymer constituted of a series of "cages" trapping the template. Once the synthesis is complete, the template molecule is extracted, leaving a molecular cavity imprinted in the polymer matrix that allows the polymer to selectively recognize the target molecule [5]. These elements are cheap, easy to synthesize and can be adapted to any kind of surface.

Using conducting polymers for building MIPs allows to get semiconductor gas sensors working at room temperature with a good selectivity. We succeeded in preparing sensors based on polypyrrole deposited by electropolymerization detecting formaldehyde in the range [100 ppb-20 ppm].

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