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Polymeric Sensing Materials for Volatile Organic Compound Sensors

Monitoring various volatile organic compounds (VOCs) is important for a variety of applications. For example, ethanol detection to prevent a person from driving while intoxicated, acetone detection in diabetic diagnosis such as diabetes, and [illegible] and benzene [illegible] any application, [illegible] present and will interact with both the analytes and the [illegible] other VOCs. This makes [illegible] identification of highly selective sensing materials difficult.

The "heart" of a sensor is the sensing material because that is what interacts with the analytes. Changing the sensing material will influence which analytes are able to interact with the sensor to produce a response. Polymers are great sensing materials since they have high environmental stability, operate at room temperature, and are relatively flexible. In addition, polymers can be tailored to selectively [illegible] a target analyte by modifying their functional groups through copolymer blending, and by adding dopants (including acids and metal oxide nanoparticles).

Multiple polymeric sensing materials were designed, synthesized, [illegible] sensing material for ethanol. Both the sensitivity and selectivity of the sensing materials were evaluated. Some of the most promising polymeric sensing materials were then [illegible] different chemical sensors: a capacitive radio frequency identification (RFID) sensor and a mass-based microcantilever microelectromechanical system (MEMS) [illegible] evaluation.

After this wide experimentation, along with what has been reported in the literature, various sensing mechanisms were proposed. These sensing mechanisms explain why certain VOCs sorb more preferentially onto certain polymeric sensing materials. Therefore, identifying the dominant sensing mechanisms for a target analyte can improve sensing material selection.

Based on appropriate sensing mechanisms, potential sensing materials can be chosen for a target analyte. This includes prescriptions that can be followed when choosing sensing materials for a target application. These prescriptions take into consideration the chemical nature of the target analyte (and its significant mechanisms by which it is likely to interact) and constraints of the target application (including operational temperature and type of [illegible] the chemical nature of the common interferents with the target analyte. These prescriptions allow one to narrow down a list of several hundred potential sensing materials to a manageable few which can subsequently be evaluated.