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Volatile Organic Compounds Detection by Surface Acoustic Wave Sensors with Nanoparticles Embedded in Polymer Sensitive Layers

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Abstract : Surface acoustic wave (SAW) sensors with nanoparticles (NPs) of various dimensions and concentrations embedded in different types of polymer sensing films for detecting volatile organic compounds (VOCs) were studied. The sensors were 'delay line' type with a center frequency of 69.4 MHz on ST-X quartz substrates. NPs with different diameters of 7 nm or 13 nm were obtained by laser ablation with lasers having 5 ns or 10 ps pulse durations, respectively. The influence of NPs dimensions and concentrations on sensor properties such as frequency shift, sensitivity, noise and response time were investigated. To the best of our knowledge, the influence of NP dimensions on SAW sensor properties with has not been investigated. The frequency shift and sensitivity increased with increasing NP concentration in the polymer for a given NP dimension and with decreasing NP diameter for a given concentration. The best performances were obtained for the smallest NPs used. The SAW sensor with NPs of 7 nm had a limit of detection (LOD) of 65 ppm (almost five times better than the sensor with polymer alone), and a response time of about 9 s for ethanol.

Keywords : surface acoustic wave sensor, nanoparticles, volatile organic compounds, laser ablation
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