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On the use of plasma-deposited thin films for gas sensors with read-out based on the SPR effect

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Sensors based on the Surface Plasmon Resonance (SPR) effect are used widely in analytical chemistry and biology due to their sensitivity down to the ppb range in the liquid phase.There has been effort to develop optical surface sensors for the detection of hazardous, e.g. toxic or flammable gases. In this presentation, examples for surface optical gas sensors are given. In many cases, the use of such devices is limited by sensitivity problems and degradation effects. Thin film coatings technology is employed to add layers for protection and sensitivity enhancement. As an example, a study about the stability, sensitivity and accuracy of gold based SPR based gas sensors with ellipsometric readout is presented. This setup is expecially reliable for gas sensing but can be improved for sensitivity, accuracy, and long-time stability by covering the gold SPR sensor layer with an additional layer, which has to be thin (<5nm) and precisely manufactured at the same time. This is an experiment very much suited for the comparison of different coating technologies apart from comparing layer materials. The best layer for stability and general sensitivity towards all kinds of gas mixtures so far is sol-gel titania due to its surface topography and porosity properties. However, a major improvement is the first successful demonstration of selectivity towards a specific gas by coating the sensor with iron doped tin oxide (Fe:SnO_2) deposited by plasma co-sputtering which shows sensitivity towards carbon monoxyde based on the catalytic oxidation of the gas by the oxide. With the Fe:SnO_2 system and a mixture of CO as analyte gas in dry air, a sensitivity of 0.5 ppm (v/v) could be achieved. Finally, the possibilities for the use of optical surface devices as gas sensors in an industrial environment are discussed.

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