NOVEL METAL OXIDE NANOSTRUCTURES FOR ADVANCED CHEMICAL SENSING APPLICATIONS

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Pulsed laser deposition is a versatile method used for deposition of different kinds of metal oxide layers. A great advantage of the method is that the film structure and morphology can be easily controlled by variation of the deposition parameters. When lower O_2 partial pressure with heated substrate is used during the deposition, the film structure is highly ordered, even epitaxial, while under high O_2 background pressure in the deposition chamber, nanoparticles start to form already during the expansion of the plasma from the target material to the substrate. In this study, we show how PLD can be used to produce highly gas sensitive nanostructured WO_3, V_2O_5, and SnO_2 layers with properties to be utilized in various different kinds of applications.

WO_3 layers were formed of tree-like formations of agglomerates consisted of small nanoparticles. The structures have been studied as a chemical sensing material towards volatile organic compounds (VOC), which have been found to cause severe health problems when inhaled from, *e.g.* indoor air. WO_3 layers were found to be extremely sensitive towards naphthalene, down to 2.5 ppb-level, and also selective when compared to other VOC's, like benzene and formaldehyde.

SnO_2 layers deposited by pulsed laser deposition were also formed of tree-like formations of agglomerates with an extremely small grain size of around 3 nm. The layers were found to extremely sensitive to carbon monoxide (CO). The size of the response to 15 ppm of CO was 88 % measured as a drop of resistance, which is considered to be extremely high.

V_2O_5 layers were formed more in the form of denser thin films and individual nanoparticles with grain size of around 50 nm with an extremely high sensitivity to NH_3, and the response to ammonia was superior when compared to the other gases. The layers were able to distinguish NH_3 from NO gas even in varying levels of CO and O_2 in the background atmosphere. Also, the sensing layers seem to have excellent electrical and thermal stability. This is a very interesting result, when considering a possible sensor application to control Selective Catalytic Reduction (SCR) process, used in, *e.g.* diesel engines exhaust system. In SCR process, harmful NO_x emissions are reduced to harmless N_2 and H_2O by adding NH_3 to the exhaust system, and to control this process, a sensitive, stable and selective NH_3 sensor is needed.