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Magnetron deposited Fe:SnO2 films with controlled morphology and a SPR gas sensors application

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The SnO_2 material is often used as a oxidation catalyst and a solid-state gas sensor. The iron doped SnO_2 coatings were made by a RF magnetron and a pulsed DC magnetron sputtering. The coatings deposited at low RF power 40W were very flat. When the pressure was decreased to 0.3 Pa pillars in diameter about 500nm and height about 500nm appeared. The pillars on thin coatings were observed mainly on dielectric samples, glass and Si, and not on conductive substrates as copper for example. Therefore an effect of local static charge was expected to be the reason for the pillar creation. The maximum density of the pillars on the surface about 0.3 mm^{-2}. It was observed for the coatings deposited for 32 minutes at the RF power 75W in the total gas flow 7 sccms at the pressure 0.3 Pa. XRD analyses found amorphous coatings, when the thickness was below 500nm. The sputtering process was investigated by the mass spectrometry. Ion fluxes of the ground and the floating electrodes were investigated. The energies of dominant Ar^+ ions were about 21 eV at gas flow 2.5 sccm and were about 20 eV at gas flow 7 sccm on the grounded electrode. The mass spectrometry study of the sputtering process identified SnO^+ to by the dominant ionized specie related to the growth of the coatings under the investigated conditions. The expected ionized and neutral species SnO_2^+ were not found. Finally, the flat layers (3-6 nm) were prepared on an Au coated glass where Surface Plasmon Resonance effect with an ellipsometric readout was used to sense gasses. Sensors were investigated toward CO and methane. The CO detection limit was in air about 0.5 ppm and the detection limit of methane in air was about 1ppm. It was not necessary to heat externally the sensor probably due to a local heating by the SPR laser beam.

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