SURFACE ACUSTIC WAVE SENSORS FOR GREENHOUSE GAS EMISSION MONITORING

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Abstract

Surface acoustic wave (SAW) and bulk acoustic wave (BAW) sensors are nowadays widely used in a variety of applications and equipments. Due to their high sensitivity, tunable specificity and small size, SAW sensors can be successfully used for applications such as temperature, mass, pressure, humidity or biological sensors. Taking into consideration the possibility of detection of small quantity of gas, but also the possibility of wireless operating mode of such a sensor, SAW based gas sensors have attracted much interest lately [1, 2, 3]. Thus, an ST-X cut quartz substrate at 262 MHz, can achieve a 0.5 ppm sensitivity for NO_2 detection [4], an Y-X cut $LiNbO_3$ substrate can achieve a 3.5% sensitivity for CO_2 and N_2 [5].
A typical SAW resonator consists of a piezoelectric substrate, onto which pair of micrometer comb-like metallic electrodes is formed. This pair of micrometer electrodes is called the interdigital transducer (IDT) respectively the reflector, forming together a resonant cavity. Considering the piezoelectric effect, a radio frequency input signal will produce an acoustic wave propagating at the surface of the substrate. In turn, the wave generated will produce an electric charge distribution onto the reflector that can be analyzed in terms of radio frequency output signal. The resonant frequency of the device can be altered by the velocity of the surface acoustic wave traveling between IDT and reflector, but also by the geometry of the interdigital pins. The sensibility of the SAW device related to the velocity of the acoustic wave can be exploited in the construction of SAW sensors, in particular the construction of gas sensors.
In this paper, we are studying the photolithography of silver delay lines onto a piezoelectric substrate, through the negative photo-resistor method. The piezoelectric substrate was prior coated with a thick layer of silver using thermal evaporation with Emitech K975X thermal evaporator. A thin film of UV photosensitive coating was form onto the piezoelectric substrate, using the spin coating technique. The image of the interdigitalised transducers was obtained using a mask printed onto transparent printing paper, with a negative colored image in black and white. The main factors that are influencing the quality of the obtained silver electrodes were presented and discussed, as follows: the affect of the speed at which the spin coating is performed, the affect of the photo-resist dilution, the affect of the UV exposure time and the dilution of the solvent used for the chemical etching of the obtained image.

References

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