C5

Acoustic sensors used for specific gas detection in our environment

V. Blondeau-Patissier, M. Vanotti, S. Ballandras

FEMTO-ST Institute, Time and frequency Department, 26, ch. de l'Epitaphe 25030 Besançon, France
virginie.blondeau@femto-st.fr

With predicted shortage of energy resources and the increasing of environmental pollution, hydrogen is seen as one of ways to store energy in several applications. However, this gas is highly explosive over 4% in air. Carbon Monoxide (CO) is produced by incomplete combustion. It is often referred to as the "silent killer" because it is virtually undetectable without using detection technology. These examples show the necessity to develop a device able to detect presence at low concentrations of gases in air. We here report on results obtained for CO and H_2 detection by using SAW devices functionalized respectively with cobalt corroles and palladium.

Surface Acoustique Waves, CO and H_2 detection

The high explosivity or toxicity and the lack of detection capability of human olfaction render CO and H_2 dangerous compounds.

Preliminary results obtained by using a specific layer as sensitive material in our experiments are given here. Pd film easily absorbs hydrogen and is a well known material for its detection [1]. H_2 absorption and desorption cause changes in density, elastic properties and conductivity of the Pd film. Cobalt corroles film was used to detect selectively CO. In all cases, processes are completely reversible [2]. During the tests, sensors have been exposed to changes of several experimental parameters (T°, flow, P°, carrier gas). In order to exclusively extract the information concerning gas absorption, we used a specific differential setup comprising two SAW devices (fig.1). Experimental measurements prove the possibility of H_2 and CO detection using this setup (fig. 2). The experiments have been repeated several times to validate the results under atmospheric pressure. Linear correlation between sensor response slopes and the applied gas flow have been observed.

These encouraging results pave the way to investigating other improved acoustic waves devices to reach lower detection thresholds and detect a smaller particles in air.

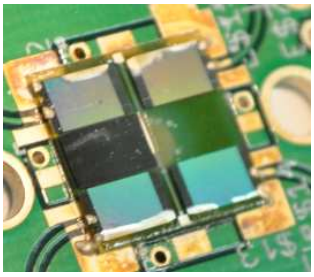

Fig. 1: A) Functionalized SAW (left) and bare (right) devices used for differential setup.

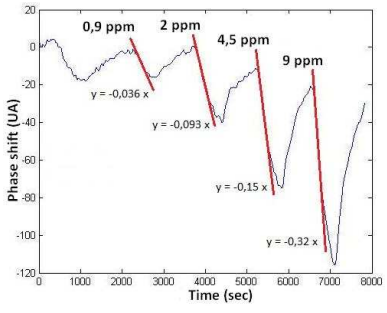

Fig. 2: Phase variation under CO flow of SAW sensor

[1] A. D'Amico, A. Palma, E. Verona, Hydrogen sensor using a palladium coated surface acoustic wave delay-line, IEEE Ultrasonics Symp. 1 (1982) 308–31.
[2] V.I. Anisimkin, I.M. Kotelyanskii, P. Verardi, E. Verona, Elastic properties of thin-film palladium for surface acoustic wave sensors, Sens. Actuators B 23 (1995) 203–208.