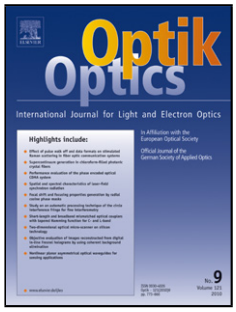

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The viscoelastic contribution to polymer-coated SAW sensor for TNT vapour detection

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Abstract

A perturbational approach is used to examine the velocity and attenuation responses of polymer-coated SAW sensor before and after vapor adsorption. To reach the goal of detecting the 500ppb level, we find the h_0 satisfying $h_0 \approx h_{res}/10$ is enough. The slope of linear part of the velocity shift for the glassy-rubbery and rubbery is greater than that of glassy film. The slope between the glassy-rubbery and rubbery is almost the same in linear part. But plasticization causes the rubbery film to easilier behave as an acoustically thick one than glassy-rubbery and glassy polymer. To keep stable oscillation in vapor sensing, the induced attenuation should be reduced as much as possible and the linear velocity changes are preferable. Therefore, the glassy-rubbery film is suitable for a chemical interface because it promotes higher sensitivity than glassy film, larger linear range than rubbery film and easier to avoid resonance than rubbery film.

Keywords

SAW, polymer coating, Viscoelasticity, TNT sensor, perturbational approach

1. Introduction

Nowadays, more and more attention is paid to guaranty the safety on public place due to terrorist attacks in the world. Detections of toxic gases and explosives have become an urgent issue. Many techniques, such as chromatographic techniques [1], ion-mobility spectrometry [2], neutron analysis [3], X-ray backscattering [4] and nuclear magnetic resonance (NMR) spectroscopy [5-6] have been studied for explosive detection. However, these techniques are quite expensive and require sophisticated instruments that are not easy for onsite application. Compared to above conventional analytical techniques, SAW chemical sensors have the potential to offer fully integrated low cost, low detection limits, high dynamic range, solid-state devices and can detect chemical toxic gases and explosives in real time.

A SAW device can be imparted sensitivity for a particular chemical species by coating the device surface with a selective adsorbent film. Absorption of chemical species into the sensitive film causes change in its properties such as (mass or viscoelasticity). As a result SAW velocity and amplitude are changed. This process of chemical transduction is translated into shift in phase and amplitude of the signal.

The performances of SAW sensors, such as sensitivity, selectivity, response time,