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## Ambient effect on sensing behavior of Pd-gate MOS structure for ethanol detection

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### ABSTRACT

In the present study, a grided Pd-gate MOS sensor have been fabricated. The capacitance of the fabricated device has been measured with varying concentration of ethanol vapor in different ambient ( $O_2$ ,  $N_2$ , Ar) at room temperature. The measurement revealed that sensor shows maximum response (change in capacitance) for ethanol in oxygen ambient amongst others. The possible sensing mechanisms of ethanol for maximal response in oxygen ambient are also given.

### 1. Introduction

Presently, significant interest has been shown for the detection and quantification of pollutant, hazardous gases/vapors (viz. ethanol, acetone, carbon monoxide etc.) in pharmaceuticals and chemical industries. These hydrocarbons are very dangerous for health because of its colorlessness and toxicity. For detection and identification of such hydrocarbons, metal-oxide semiconductors such as  $ZnO$ ,  $SrO_2$  and  $TiO_2$  etc are most promising materials. The sensing films of these materials offer low cost, long-lasting, better sensitivity as well as selectivity over conventional solid state gas sensor [1]. Metal-oxide Semiconductor (MOS) structure based on Silicon dioxide ( $SiO_2$ ) and Titanium dioxide ( $TiO_2$ ) with catalytically active materials (Pd, Pt, Ni etc.) as electrode yielded better sensitivity for hydrogen and hydrogen containing molecules [2]. Titanium dioxide ( $TiO_2$ ), a widely studied transition metal oxide, has distinctive importance in the gas-sensing field due to its non-poisonous nature and maximum polarizability in contrast with  $SiO_2$ . Different methods have been employed with  $TiO_2$  as sensing material in the form of thick/thin and nano-crystalline film for detection of alcohols, hydrogen, ethylene etc. [3].

In the present work, a grided Pd-tisin sensor [4] (Pd/ $TiO_2$ /Si MOS sensor) is fabricated for the detection of hydrocarbons such as ethanol in variant ambient ( $O_2$ ,  $N_2$  and Ar). Results indicate that MOS sensor displays maximal response to ethanol in oxygen ambient among other ambient tested.

### 2. Experimental

The Pd-gate MOS sensor has been fabricated by evaporating  $TiO_2$  over a thoroughly cleaned p-type <111> silicon wafer having resistivity 3-6  $\Omega$ -cm. Resistive heating technique is used to deposit  $TiO_2$  film at partial pressure of  $5 \times 10^{-3}$  Torr in a