

Chemical Sensors for High Temperatures Based on Silicon Carbide

Amir Arbab, Anita Spetz, Qamar ul Wahab,
Magnus Willander and Ingemar Lundström

Department of Physics and Measurement Technology,
University of Linköping, S-581 83 Linköping, Sweden

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Platinum metal gate-silicon dioxide-silicon carbide (MOSiC) capacitors have been operated to about 800°C. They have been tested as high-temperature gas sensor devices. The response to hydrogen was tested between 100°C and 800°C. Fresh samples with platinum gates 50 nm thick or 100 nm thick annealed at 700°C showed a very large dynamic range for hydrogen in air, from about 2.5 ppm of hydrogen to above 5800 ppm. Methane pulses of 1% in air (which is well below the explosion limit) could easily be detected.

1. Introduction

Gas-sensitive field-effect devices based on silicon technology have found many interesting applications.⁽¹⁻⁵⁾ The hydrogen sensor with a palladium gate is used, for example, in leak detectors.⁽⁶⁾ In this sensor hydrogen molecules or hydrogen-containing molecules are dissociated on the catalytic metal surface. Hydrogen atoms diffuse rapidly through the metal to the metal-oxide interface. The hydrogen atoms adsorbed at the interface act as a dipole layer, which lowers the flat band voltage of a metal-oxide-semiconductor (MOS) capacitor or the threshold voltage of a field-effect transistor. Field-effect devices based on silicon are, however, necessarily limited to operation temperatures below about 280°C. There are, however, several reactions which will occur on the catalytic metal gate of such devices only at temperatures well above 280°C. The use of field-effect devices for gas sensing should