AIME-GSWO3
Low energy semiconductor gas sensor based on WO_3 nanorods particles

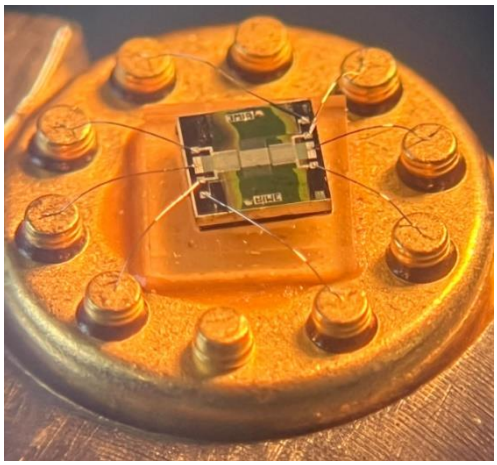
Boukezzata Aymen, Berton Thomas, Lievre Agathe, Nguyen Assia, Meslouh Arselan

Overview:

$AIME - GSWO3$ semiconductor gas sensor developed by INSA Toulouse student during their ISS (Innovative Smart System) training program in the AIME (Atelier Interuniversitaire Micro-nono Electronique). The gas sensor is based on Tungsten Trioxide WO_3 nanorods particles with 2 sensitive active sides, a wide $N - doped\ Poly - silisium$ layer used to heat the sensor up to $300°C$, and an aluminium resistor layer to measure the temperature of the sensor.

Features:

- Detection of Ammonia gas NH_3
- Detection of Nitrogen dioxide NO_2
- Detection of Ethanol gas C_2H_6O
- Double integrated sensors
- Temperature sensor
- Thermal resistor
- Low cost
- Low energy consumption
- Easy-to-use



Pinout configuration

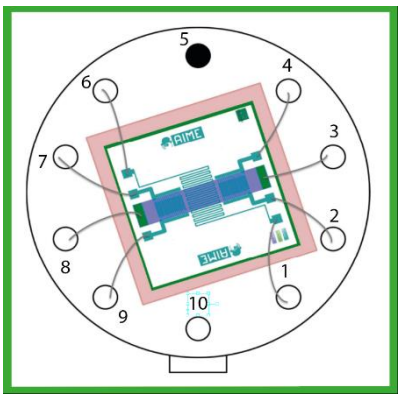


Figure 1: pinout gas sensor

Pin number	Usage
1/6	Temperature sensor (Aluminium resistor)
2/4	Gas sensor 1 resistor
3/8	Heater resistor (Polysilicon resistor)
7/9	Gas sensor 2 resistor
5	Not connected
10	Not Connected

Type	Chemical sensor
Materials	• Silicon • N-doped poly-silicon (heater) • Aluminum (temperature measurement) • Nanoparticles of tungsten trioxide (WO_3)
Sensor type	Active (power supply required)
Gas measurement	Resistive measure
Temperature measurement	Resistive measure
Detectable gaz	• Ammonia (NH_3) • Ethanol (C_2H_6O)
Package	TO-5-10 (10 pins)
Head Diameter	9.5mm
Head Height	4.7mm
Package Height	25mm
Pin Diameter	0.6mm
Mounting	Through hole fixed (THT)
Detectable Gases	∘Nitrogen dioxide (NO_2) ∘Hydrogen sulfide (SO_2) ∘ (ethanol C_2H_6O) ∘Carbon monoxide (CO) ∘Dihydrogen (H_2) ∘Methane (CH_4) ∘Alcohols (-OH)
Typical detection range	>1ppm

Electrical characteristics

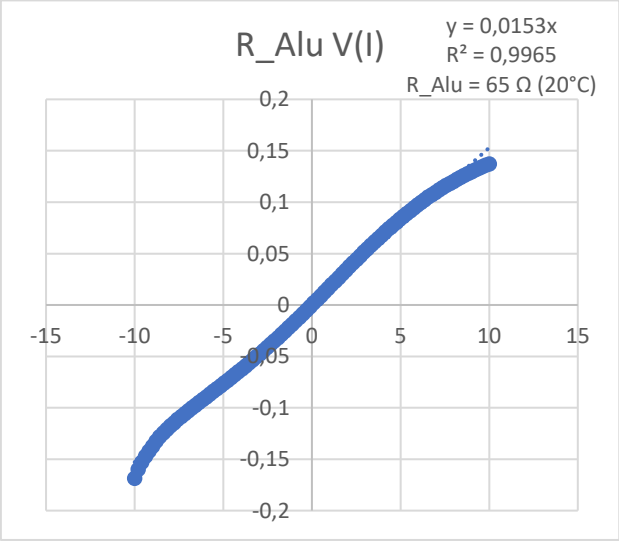


Figure 3: Current/Voltage characteristic of the sensor resistor (aluminium) at 20°C

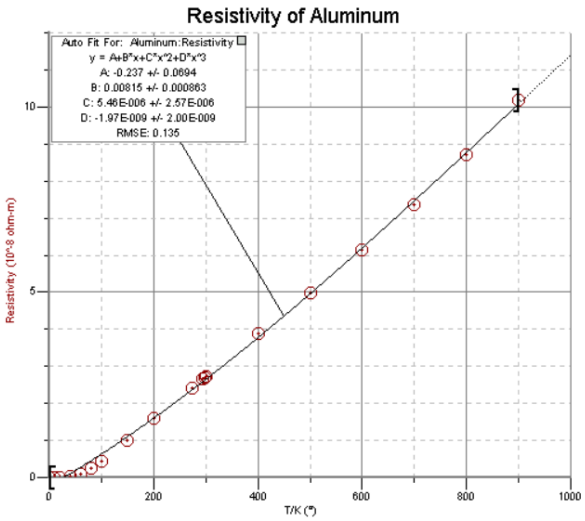


Figure 2: Resistivity of aluminium Val Polyakov -- 2004

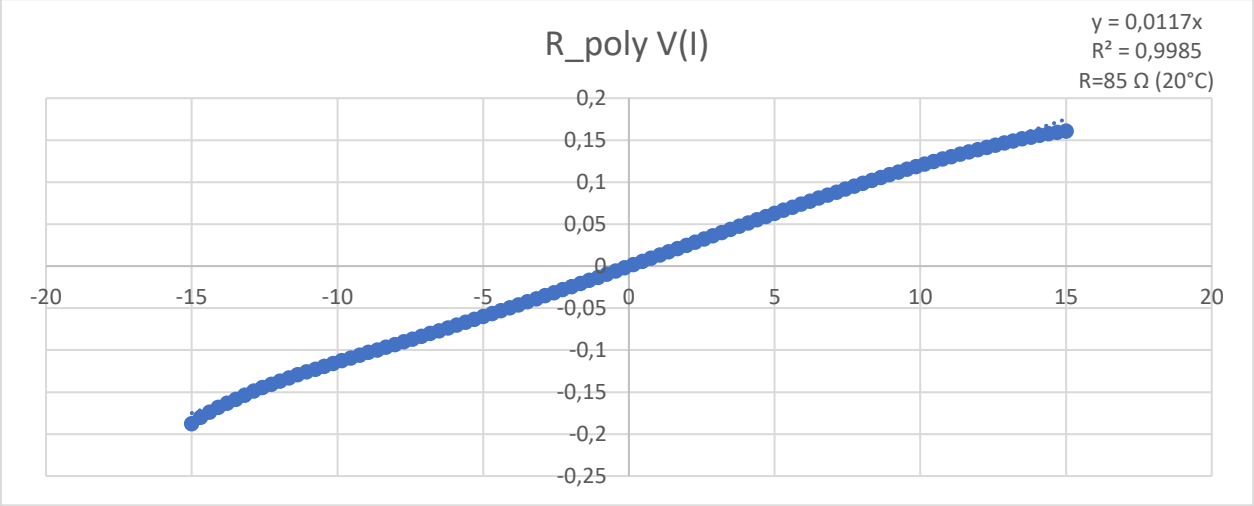
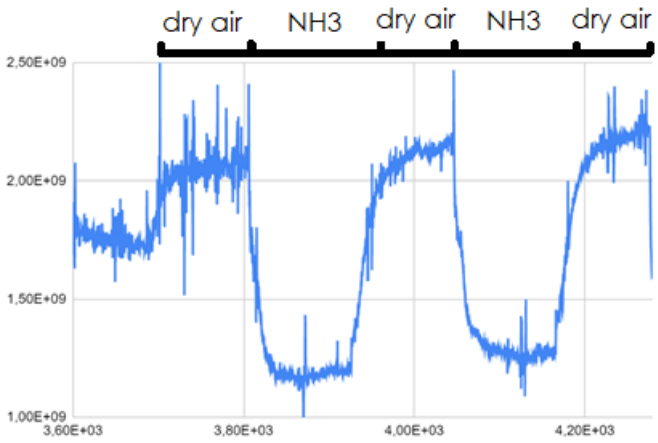


Figure 4: Current/Voltage characteristic of the Heating resistor (polysilicon) at 20°C

	Unit	Value		
		Min	Typical	Max
Gas sensor resistance	GΩ	0.01	1	100
Temperature sensor resistance	Ω	57	65	-
Heater resistance	Ω	70	85	-
Gas sensor voltage	V	-	3.3	-
Temperature sensor	V	3.3	5	-
Heater	V	10	15	20

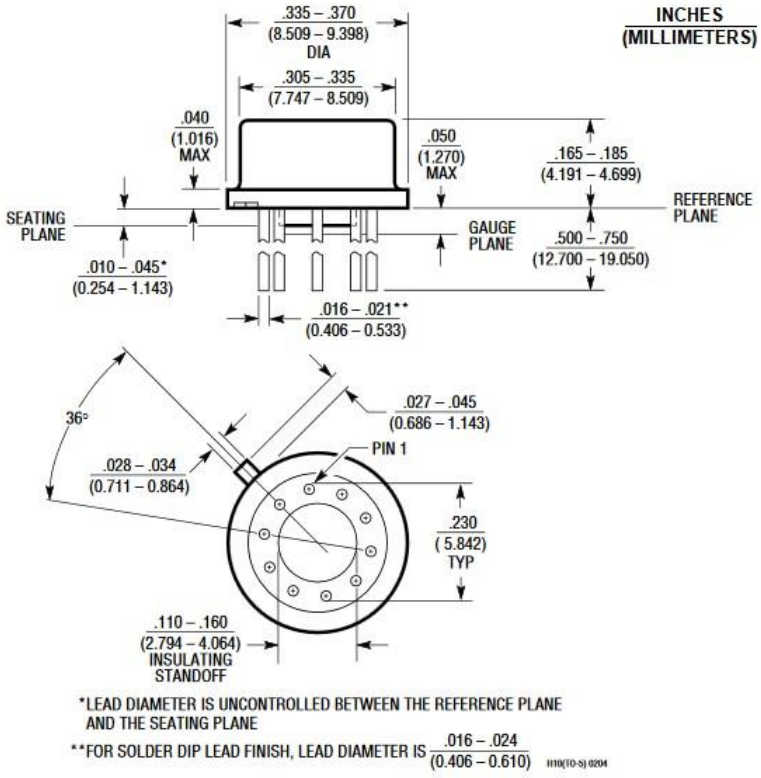
Fig 3 : Current/Voltage characteristic of the Heating resistor (polysilicon) at 20°C

Gas sensor characteristics

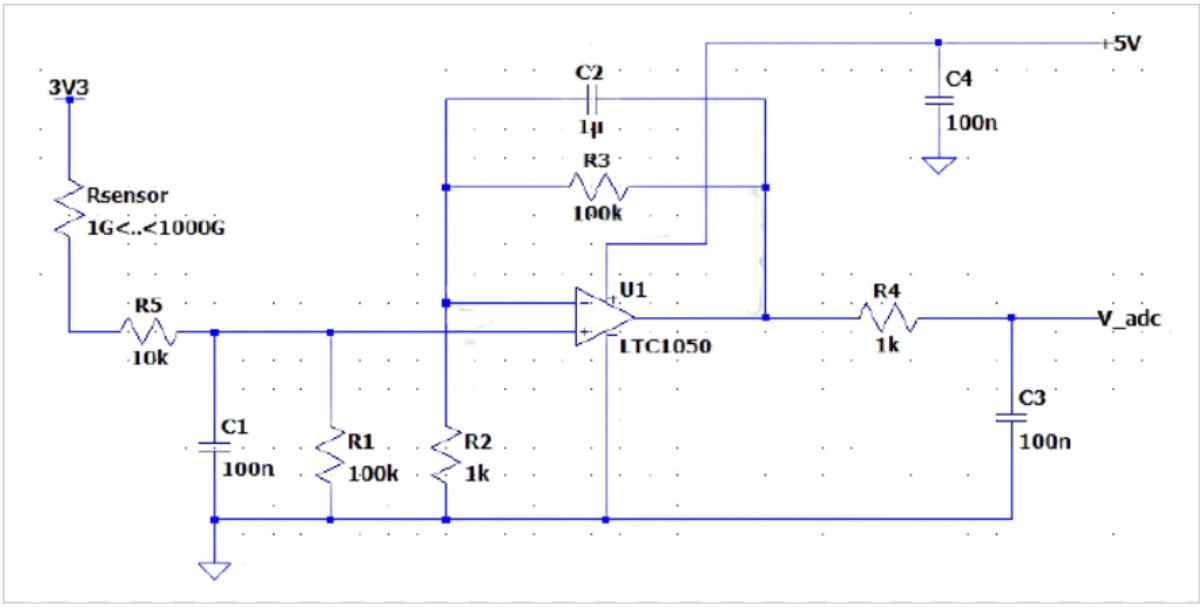


Dimensions

The package is a 10-Lead TO-5 metal :



Typical Applications



the resistance of the sensor is in the order of giga ohm a voltage divider is not efficient to measure the voltage. the above circuit uses an operational amplifier with a low offset voltage to convert the sensor current into resistance with this formula:

$$R_{sensor} = \left(1 + \frac{R_3}{R_2}\right) \cdot R_1 \cdot \frac{Vcc}{V_{adc}} - R1 - R5$$