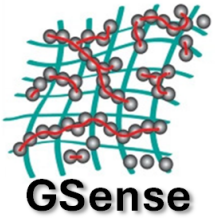

Academic Year 2023 – 2024

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

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Datasheet: graphite sensor project

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Abstract

In this project, we have developed a PCB mounted on an Arduino shield that is able to measure data both from a commercial flex sensor and from a handmade graphite sensor. The aim of the project is to prove that a handmade graphite sensor can be more sensitive to flexion than a commercial flex sensor, at least for very high resistance values (of the order of 50 to 100 MOhm). For developing this project, we have based our work in the publication from Wei et al. "Pencil drawn strain gauges and chemiresistors on paper" (2014).

Keywords: graphite sensor, chemristors, Arduino, Android application, flex sensor

Contents

1 Main features of the graphene-based sensor

The main **features** of the graphene-based sensor are:

— **Strain gauge**
— **Low-tech**
— **Low-cost**
— **Low power consumption**

2 General description of the graphene-based sensor

This low technology graphite-based sensor is based on the publication "Pencil drawn strain gauges and chemiresistors on paper" from Wei Lin et al. (1). This strain gauge is composed of a piece of paper on which layers of graphite are deposited by drawing with pencils. These strain gauges can be used to measure resitances of the order of the giga-Ohm.

The principle of this sensor is based on the link between resistance and the mean distance between graphite particles. With deformation, in tension and compression, the particles' mean distance changes, as well as the resistance.

Before using these strain gauges, an electrical circuit is needed to amplify the sensor signal.

For further information on the phenomena behind the resistance change and the electrical circuit to measure it, please visit our GitHub.

3 Sizes of the sensor

In this part are presented the sensor's main features.

Dimension Capteur (mm)	A	4	B	10	C	1
	D	24	E	2		

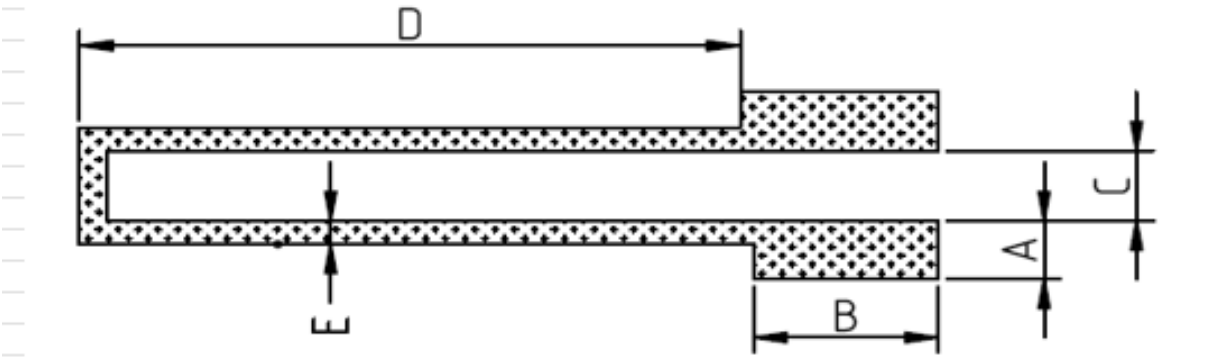

Figure 1 – Sensor dimensions in millimeters. Extracted from Gaich and Stephen's GitHub.

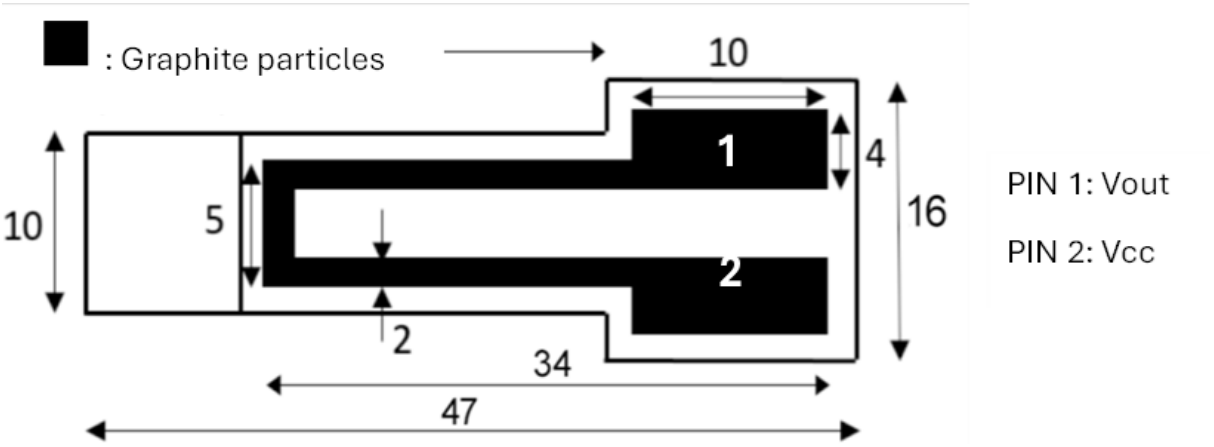

Figure 2 – Diagram for the graphene-based sensor. The units are in mm. Extracted from the work of Paul Besnard and Niels Brun, available on GitHub.

4 Handmade graphite sensor vs. commercial flex sensor: results

The complete results can be found in our GitHub site, in an Excel file, where can be found the results for each of the five types of pencil studied. It was a personal choice not to study the 3H and the HB pencils, since we thought we had enough data for drawing a conclusion with the 5 pencils we had studied.

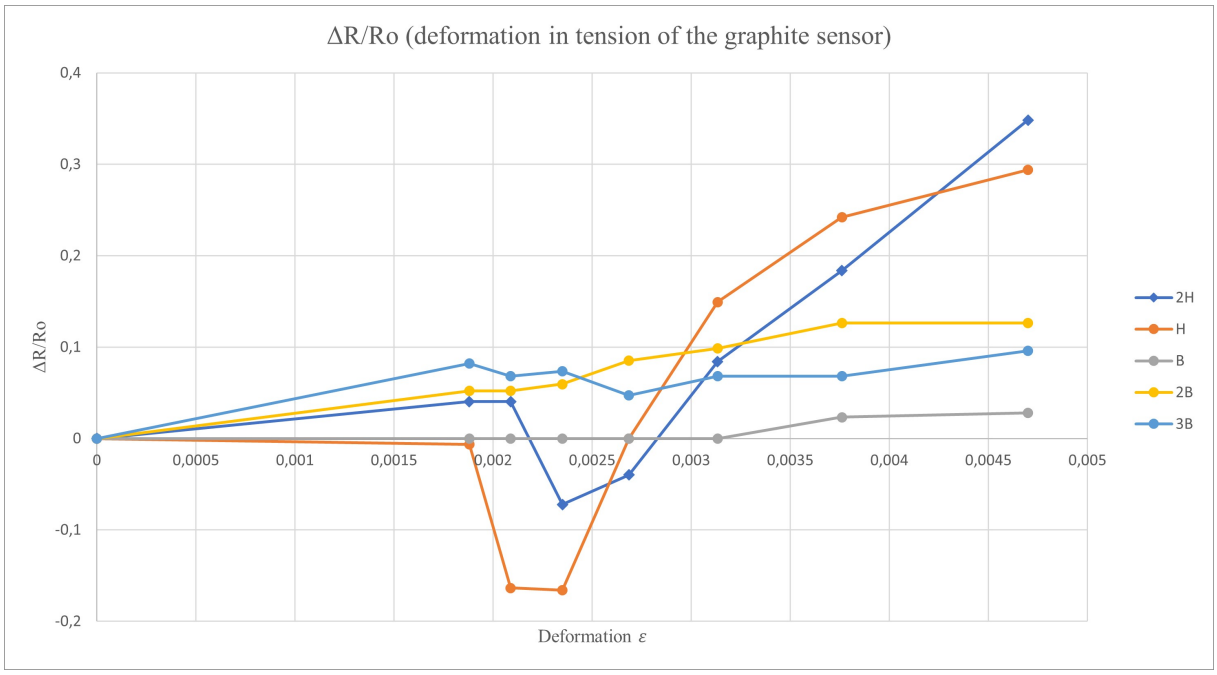

Figure 3 – Results obtained for the graphite sensor for a deformation in tension and for different H and B values.

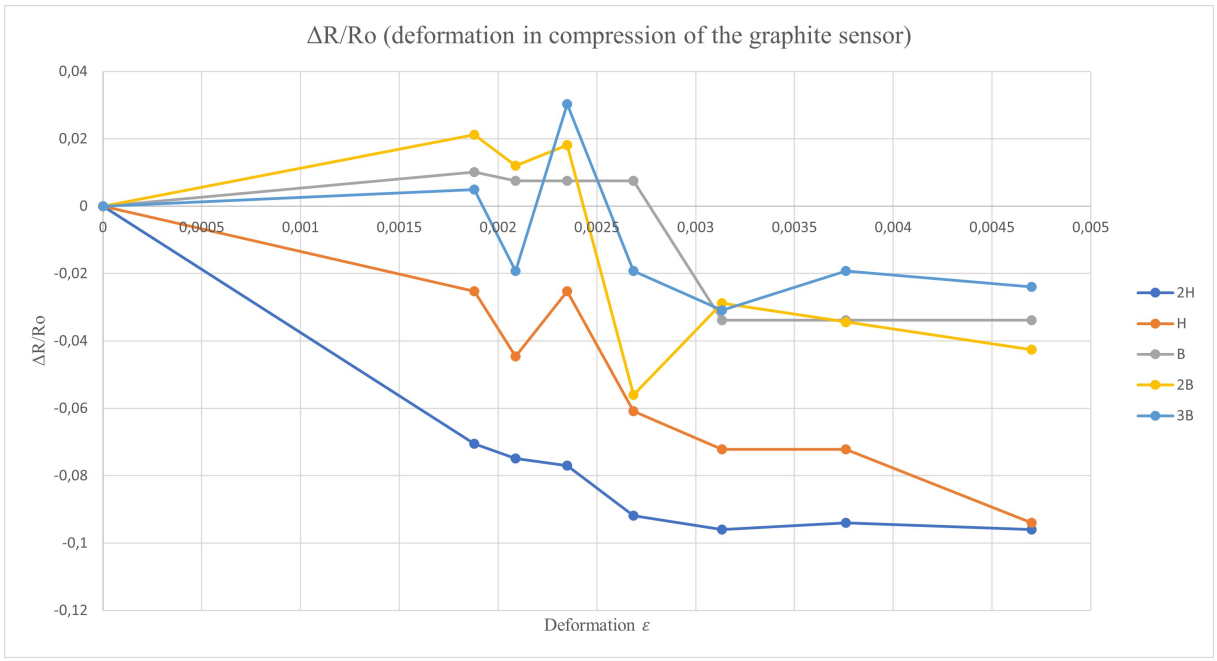

Figure 4 – Results obtained for the graphite sensor for a deformation in compression and for different H and B values.

The conclusion that can be extracted from figures 3 and 4 is that, both for tension and compression, the

harder the pencil is (the higher its "H" number is), the most sensitive the sensor is.

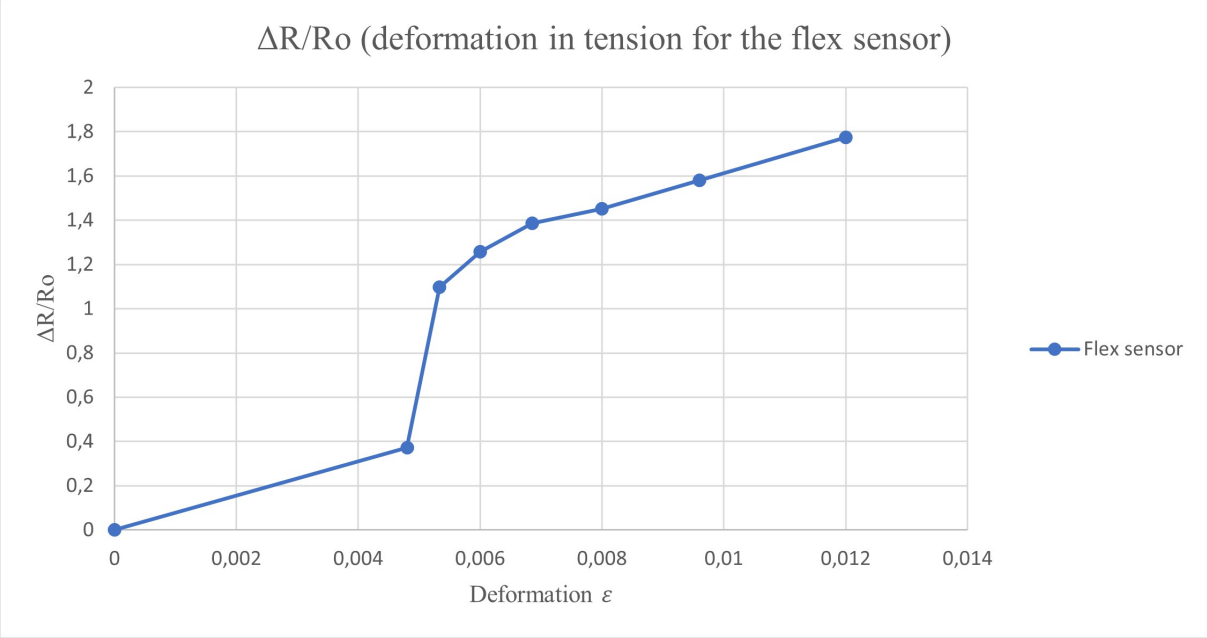

Figure 5 – Results obtained for the commercial flex sensor for a deformation in tension.

It can be seen that, for our case, the commercial flex sensor, which is only capable of measuring tension values, is more sensititve than our handmade graphite sensor. This could mean that our measures were faulty at some point, in the method or in the material being used, since the electrical circuit was the same than the one used in class and it seemed to be correct.

On top of this, some of our colleagues have found that the flex sensor is less sensitive than the handmade graphite sensor, which could mean that the sensitivity of the latter is highly dependent on factors that were not under control in our case.

References

[1] C.-W. Lin, Z. Zhao, J. Kim, and J. Huang, "Pencil drawn strain gauges and chemiresistors on paper," *Scientific reports*, vol. 4, no. 1, p. 3812, 2014.