

Investigating Potential Applications of Humidity Fabric Sensors

MANCHESTER
1824

The University of Manchester

Student: Fan Ping, Supervisor: Yi Li, Department of Materials

Abstract

This research project aims to study the potential applications of a new fabric humidity sensors, which can provide reliable and accurate measurements of the amount of water in the atmosphere.

The key objectives of this project include :

- Determine the changes in humidity levels when a person breathes;
- Determine the change patterns in humidity levels when a person is speaking different words.
- Determine the change patterns in humidity levels at different depths in the soil.

Introduction

- Electronic devices that measure the amount of moisture (humidity) in the environment and convert it into an electrical signal are called humidity sensors.
- Humidity sensors measure the water quantity in the surrounding air. The sensors are utilized in industries such as biomedical, semiconductors, textile, food processing, and pharmaceuticals.
- The materials that best fit to use in humidity sensing include metal oxides, hydrogel, polymers, nanoparticles, and CNTs.
- The various sensing techniques like thermal conductivity, gravimetric, and optical methods are all applicable for humidity sensing.

Research Methodology

The humidity sensor samples used in the experiment is a small piece of cloth, as shown in Fig.1. The sample cloth is attached to a plastic board, which connects the digital multimeters with conductive wires.

Experiment 1: The breathing experiment involves turning on the multimeters and breathing the sample while wearing a mask. If one usually breathes, the graph drops slightly less up and down. The graph of holding one's breath is not affected and is a smooth line.

Experiment 2: In the speak experiment, we measure how the number goes up and down as we speak different words. For instance, the word "hi" has one notch and one peak, whereas the word "fashion" has two heavy sounds, i.e. "F" and "S", with two peaks.

Experiment 3: In the soil experiment, we place one sensor in the soil and stick one sensor on the beaker.

Experiment 4: In the testing experiment, we take the same sample and attach it to the multimeters, and put it in the water, then take it out. Doing it three times for testing.

Experimental Setup



Figure 1: Preparation and use of humidity sensors

Results

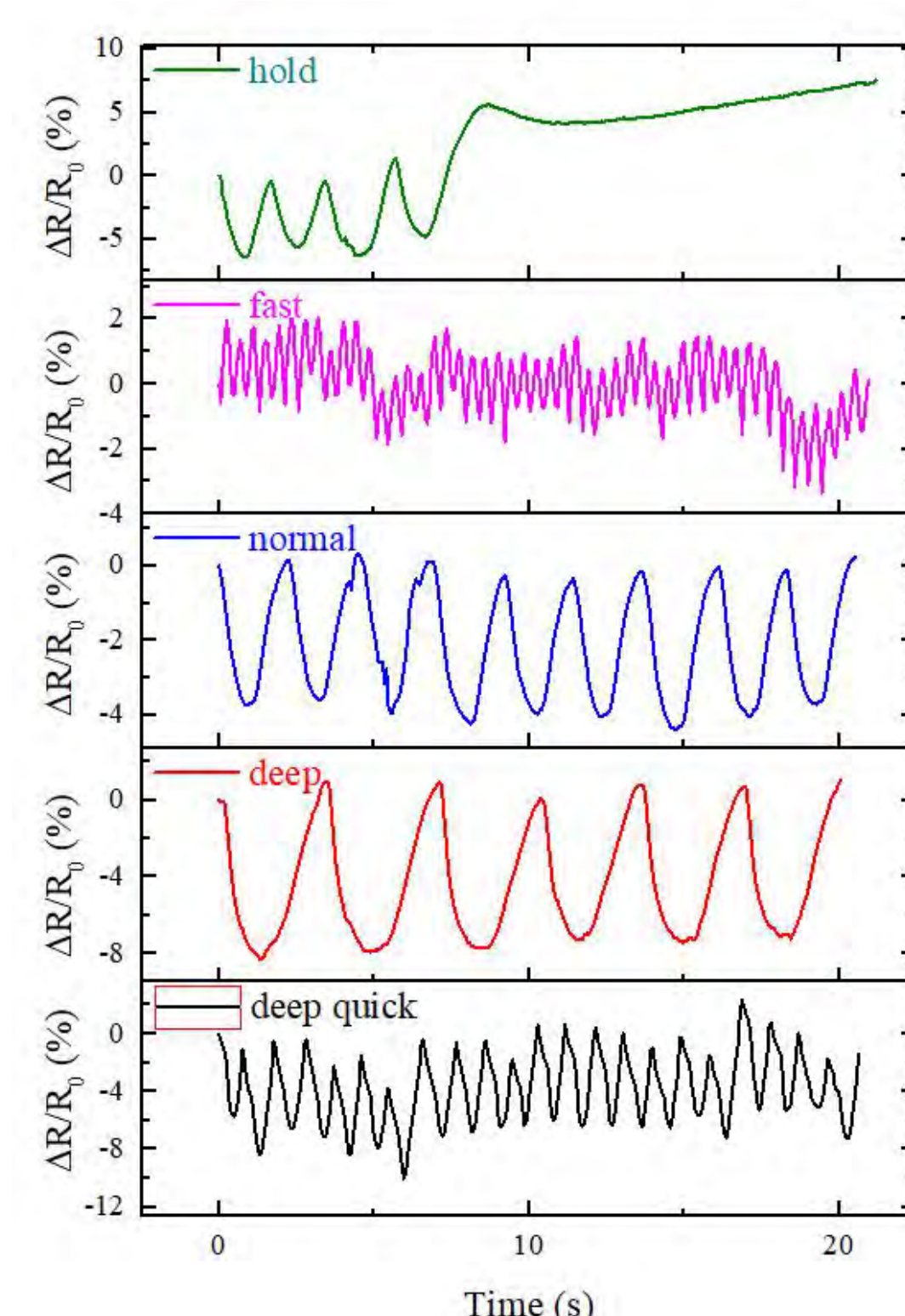
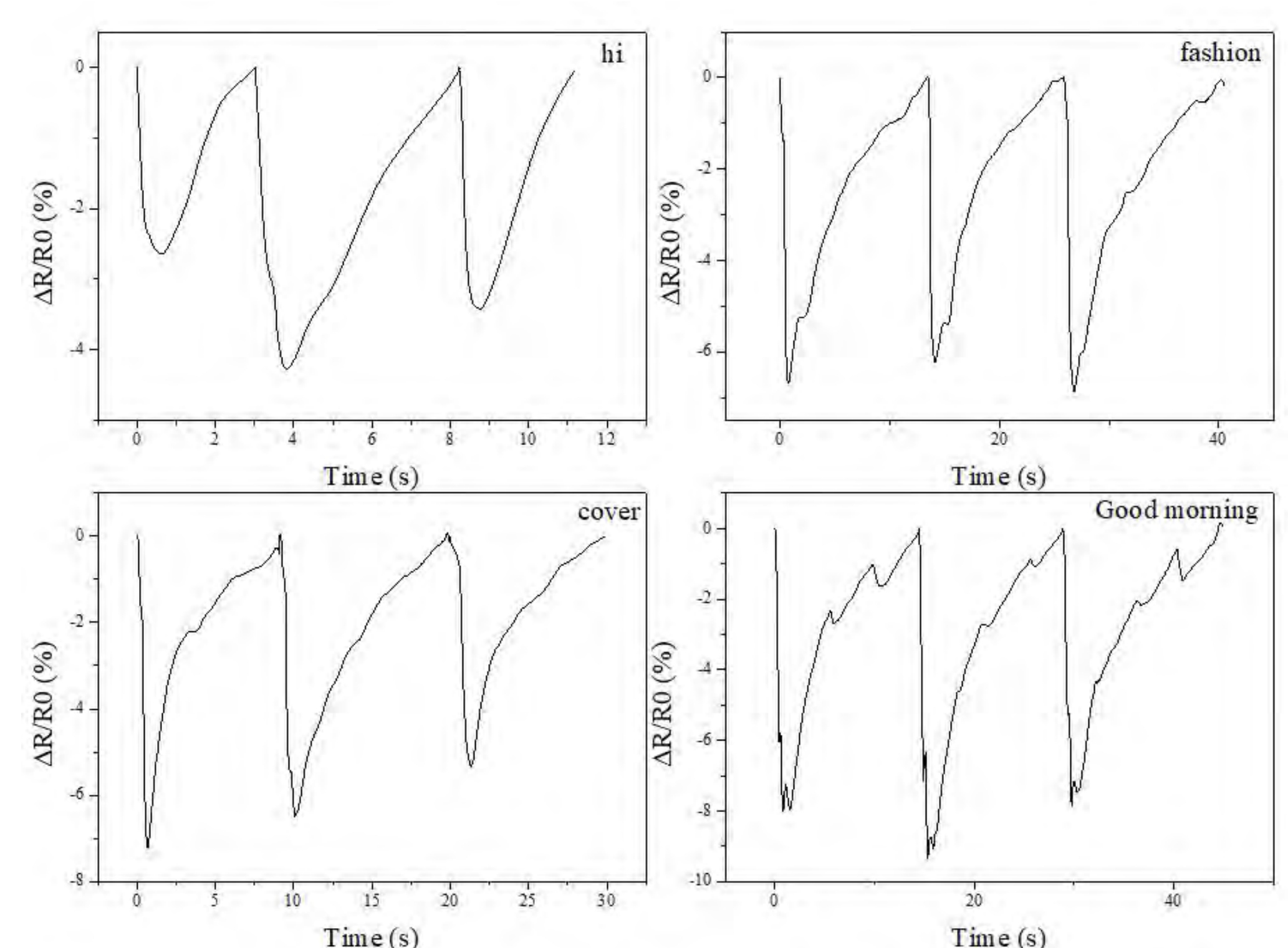


Figure 1: Humidity changes during breathing



D=Figure 2 Humidity changing patterns during speaking

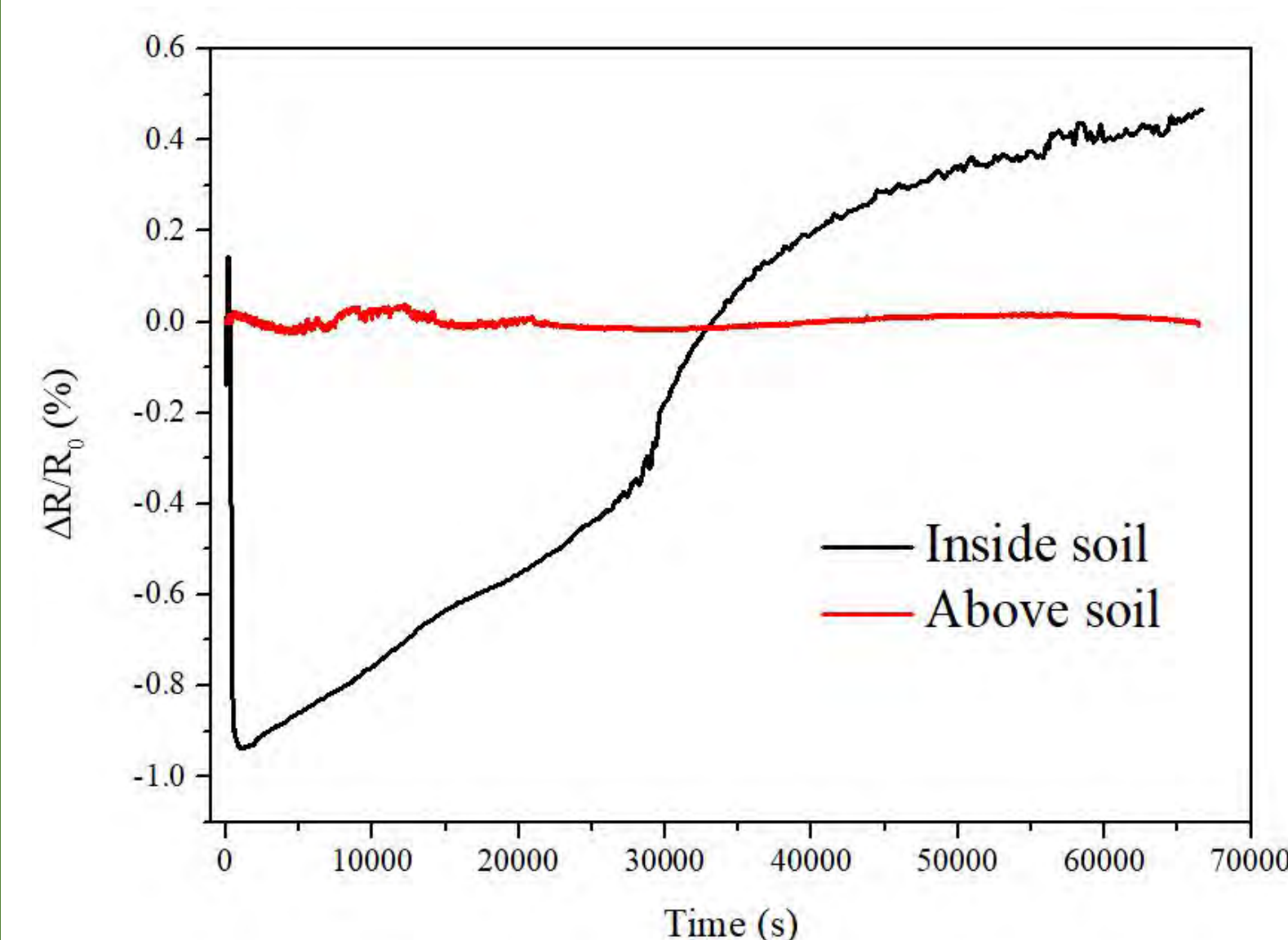


Figure 3: Humidity changes in the soil

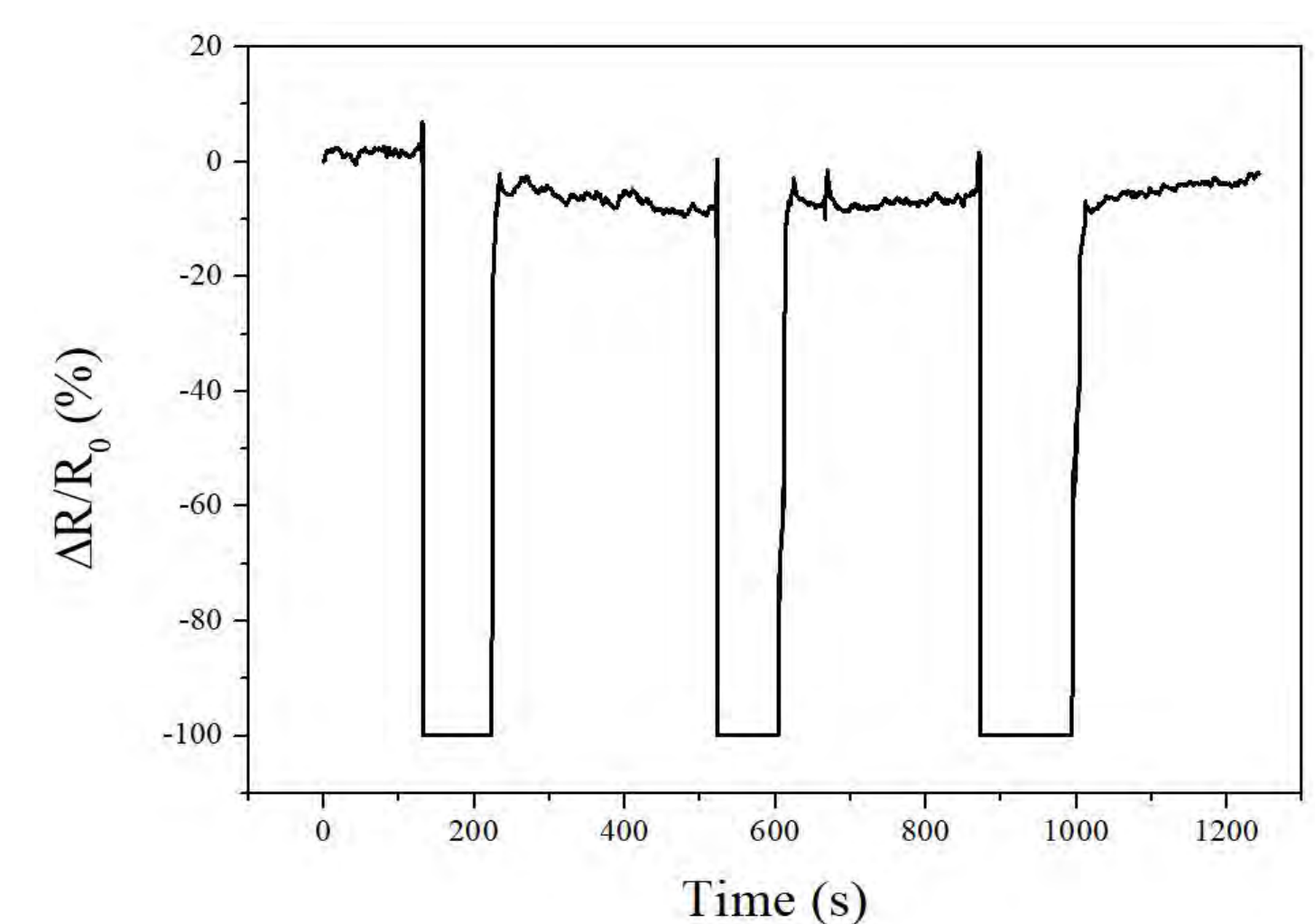


Figure 4: Responses of the humidity sensor when putting into water

Conclusions

The examination of the project's potential applications of humidity sensors shows that:

- The fabric humidity sensors with perfect flexibility, sufficient flexibility, and suitable stability are most suited for mounting on the human body.
- The fabric humidity sensors demonstrated the potential applications in monitor human activity and physiological responses.
- The fabric humidity sensors can be plied to monitor the water content level in the soil.
- The fabric humidity sensors is wettable and can be used to measure the wetness of skin and soil.

The project demonstrated promising solution to the critical challenges of humidity sensors. Manufacturing, pre-production, and sensor performance are all considered potential points of contention.

Acknowledgements

We are thankful to Prof. Yi Li for his academic guidance and support, PhD. Student Yangpeiqi Yi for assistance with instrumentation, data processing, and the University of Manchester for providing laboratory and experimental equipment.