Laser-induced graphene on renewable substrates as a platform for integrated sensing

A.F. Carvalho, B. Kulyk, A.J.S. Fernandes, E. Fortunato, F.M. Costa

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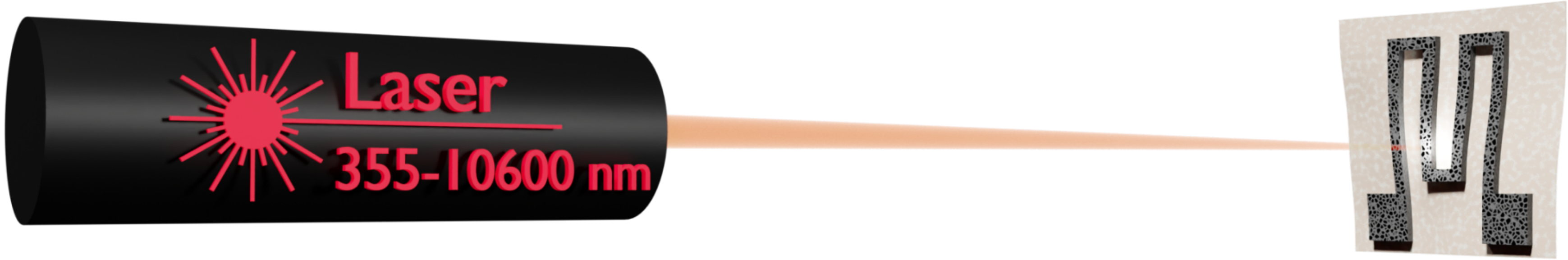

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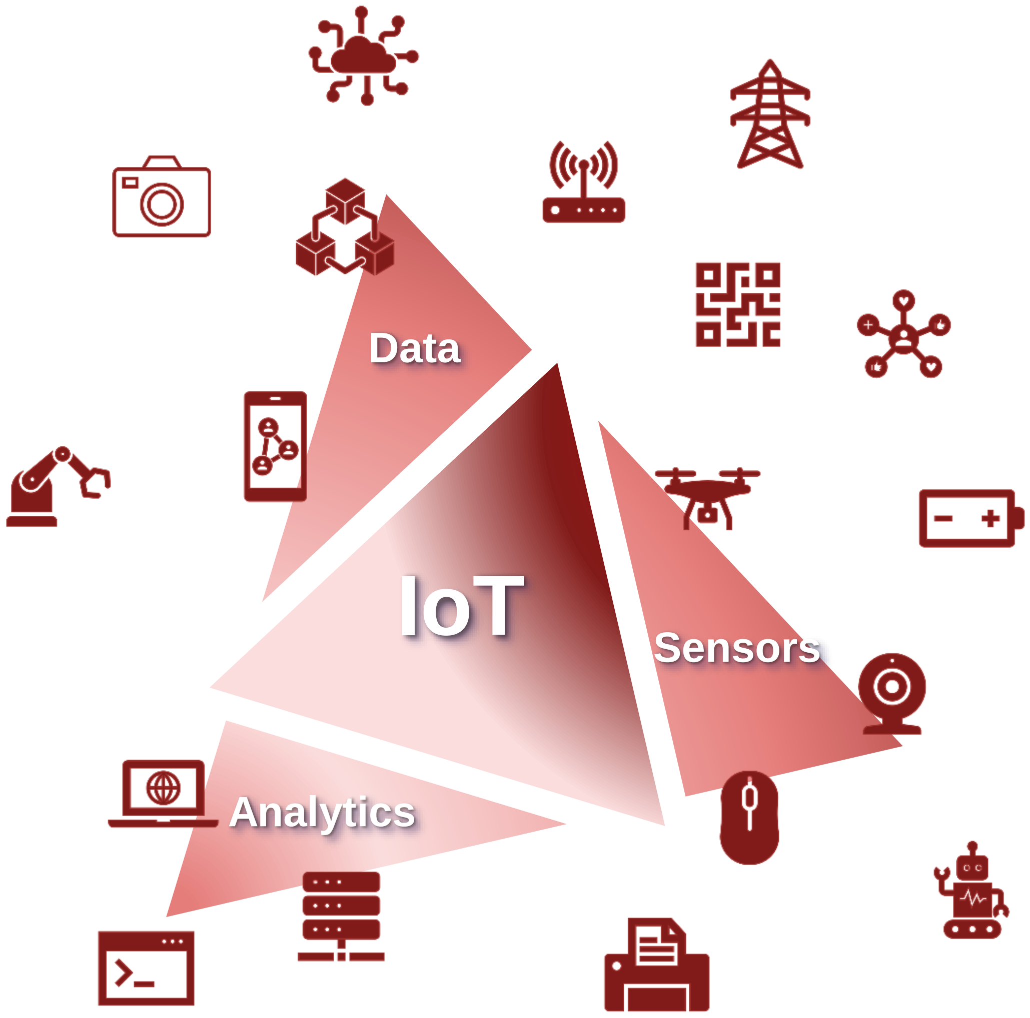
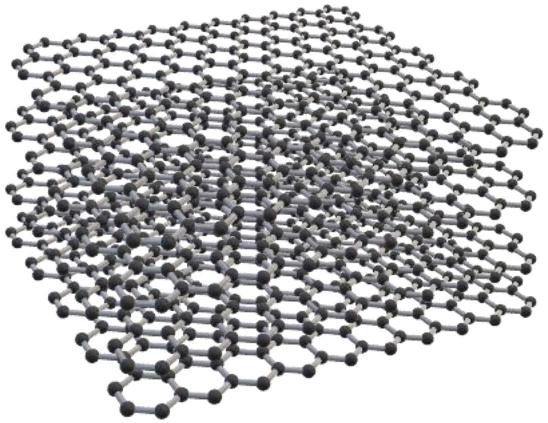
How to accommodate two different paradigms?

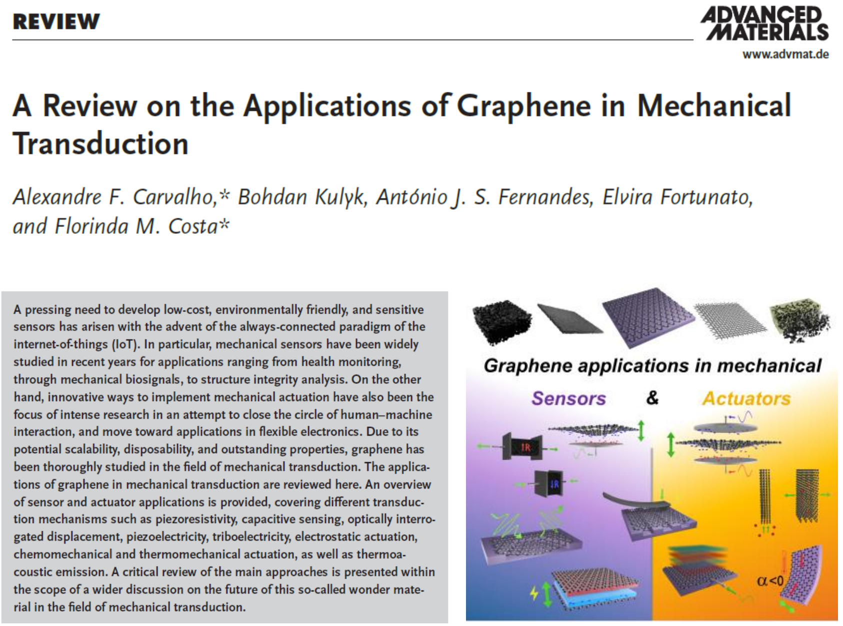


Graphene as green physical sensing element

- 2D conductive form of **Carbon**
- Sensitive to different physical stimuli
- Lightweight and potentially green and inexpensive

Graphite
Graphene




REVIEW

ADVANCED MATERIALS
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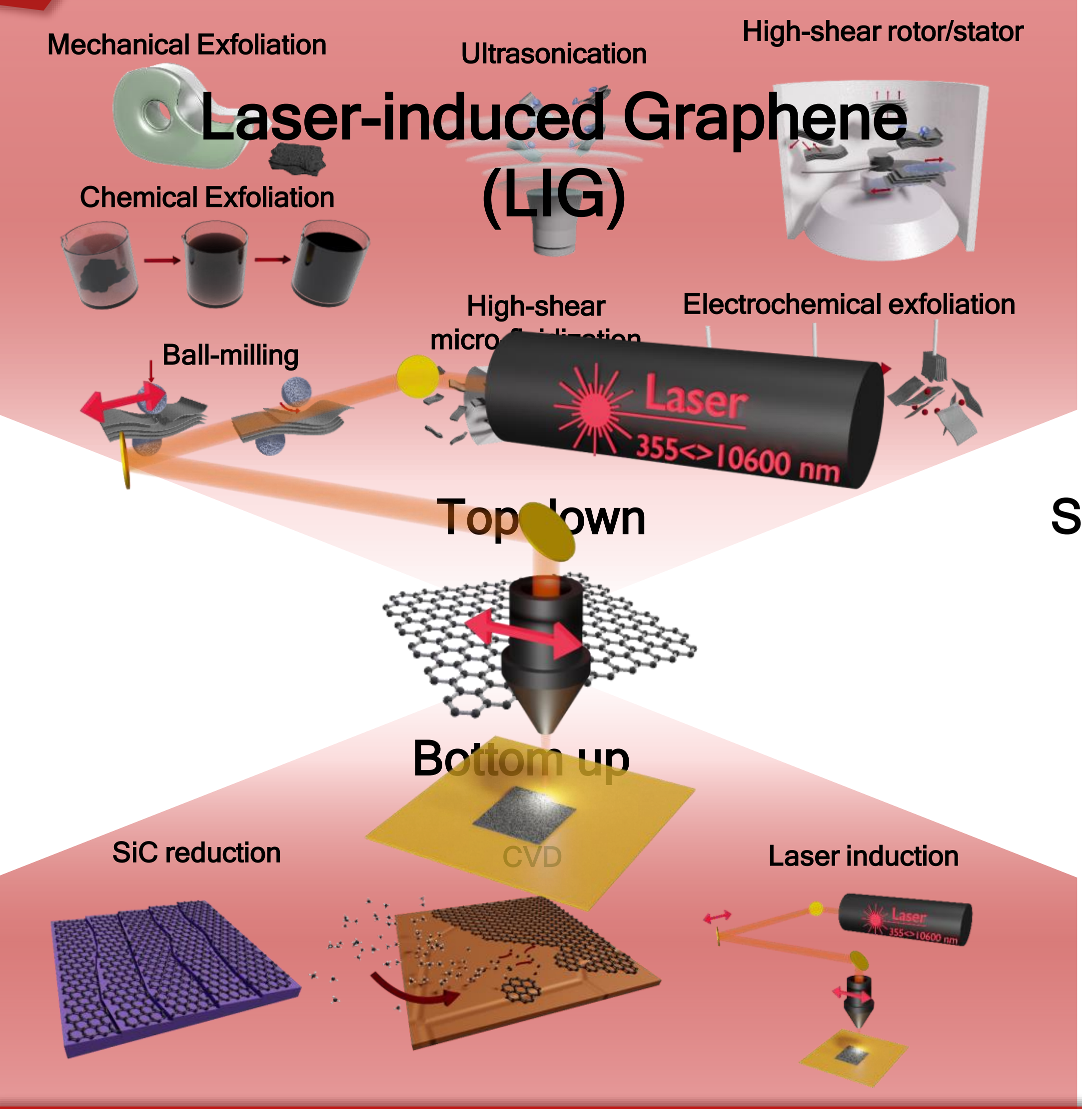
A Review on the Applications of Graphene in Mechanical Transduction

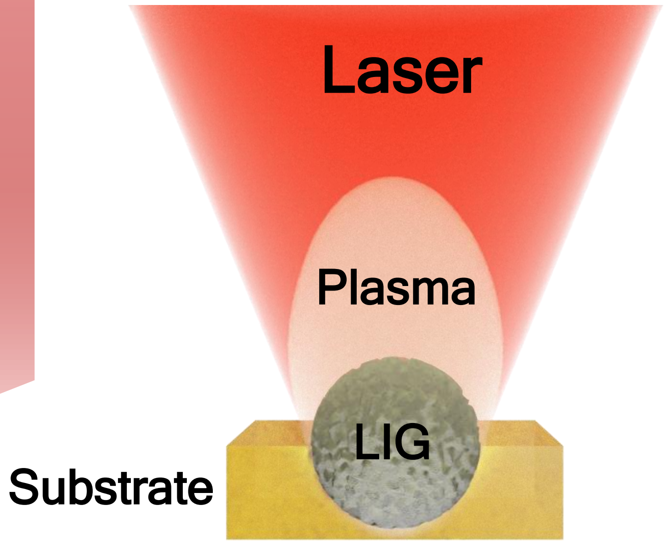
Alexandre F. Carvalho, Bohdan Kulyk, António J. S. Fernandes, Elvira Fortunato, and Florinda M. Costa**

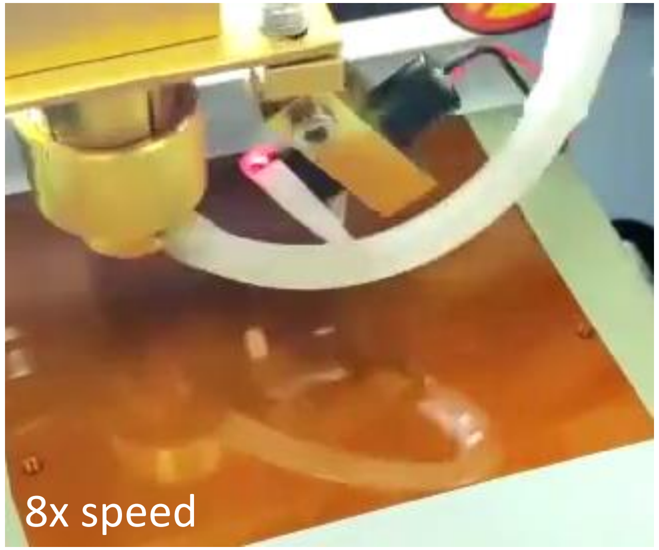
A pressing need to develop low-cost, environmentally friendly, and sensitive sensors has arisen with the advent of the always-connected paradigm of the internet-of-things (IoT). In particular, mechanical sensors have been widely studied in recent years for applications ranging from health monitoring, through mechanical biosignals, to structure integrity analysis. On the other hand, innovative ways to implement mechanical actuation have also been the focus of intense research in an attempt to close the circle of human–machine interaction, and move toward applications in flexible electronics. Due to its potential scalability, disposability, and outstanding properties, graphene has been thoroughly studied in the field of mechanical transduction. The applications of graphene in mechanical transduction are reviewed here. An overview of sensor and actuator applications is provided, covering different transduction mechanisms such as piezoresistivity, capacitive sensing, optically interrogated displacement, piezoelectricity, triboelectricity, electrostatic actuation, chemomechanical and thermomechanical actuation, as well as thermoacoustic emission. A critical review of the main approaches is presented within the scope of a wider discussion on the future of this so-called wonder material in the field of mechanical transduction.

Necessity

Graphene Production and Laser-induced graphene (LIG)



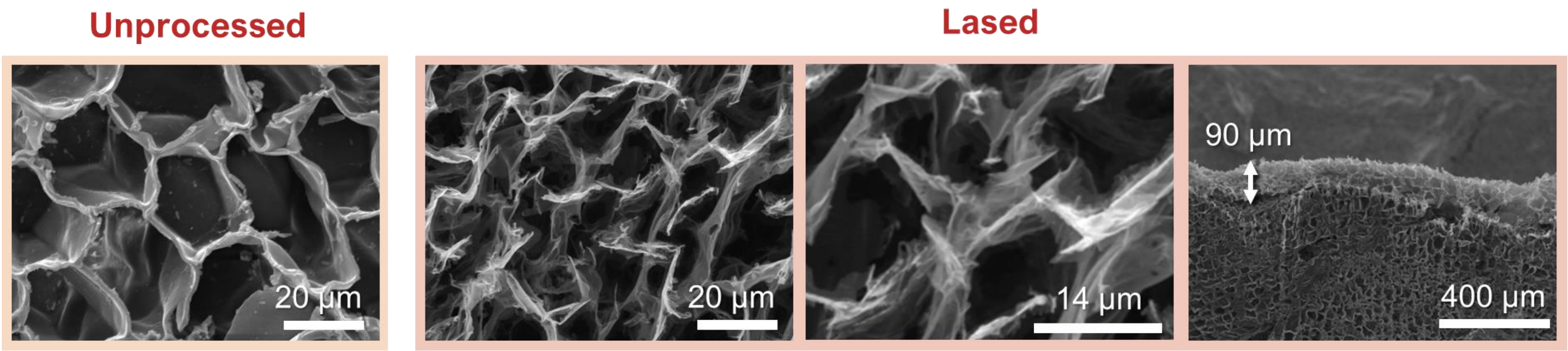


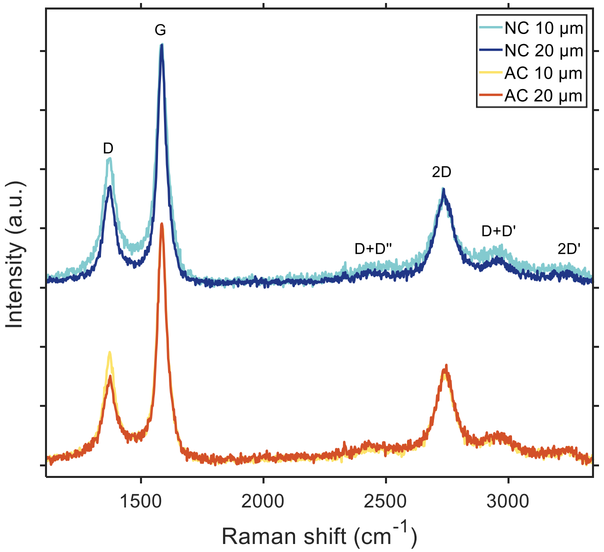


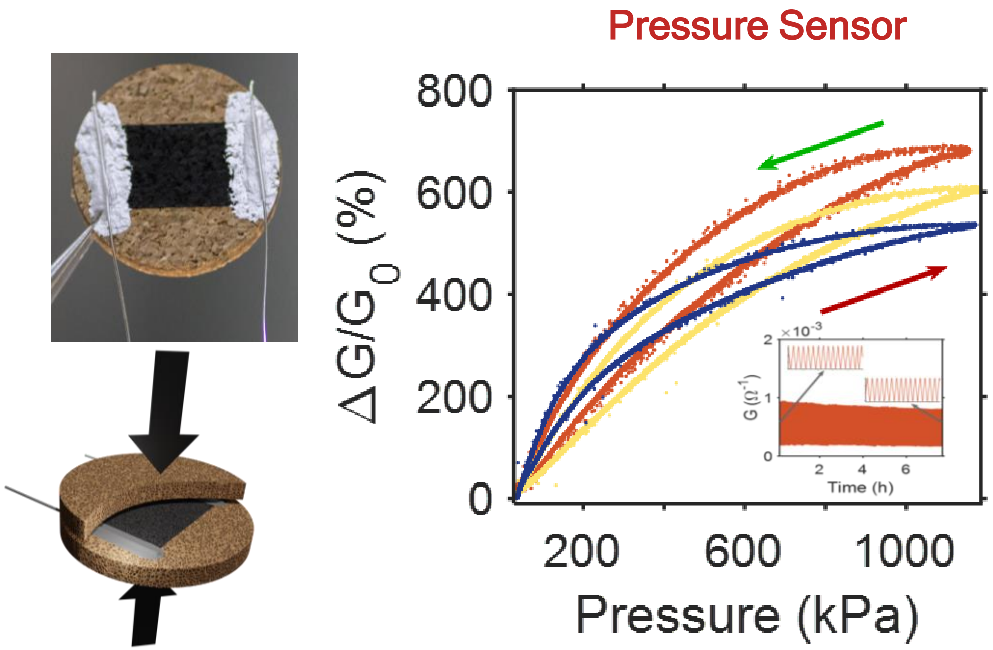
- Fast and inexpensive way to directly pattern graphene onto a pyrolysable substrate
- Arbitrary shapes can be produced
- Green process if **sustainable substrates** are used

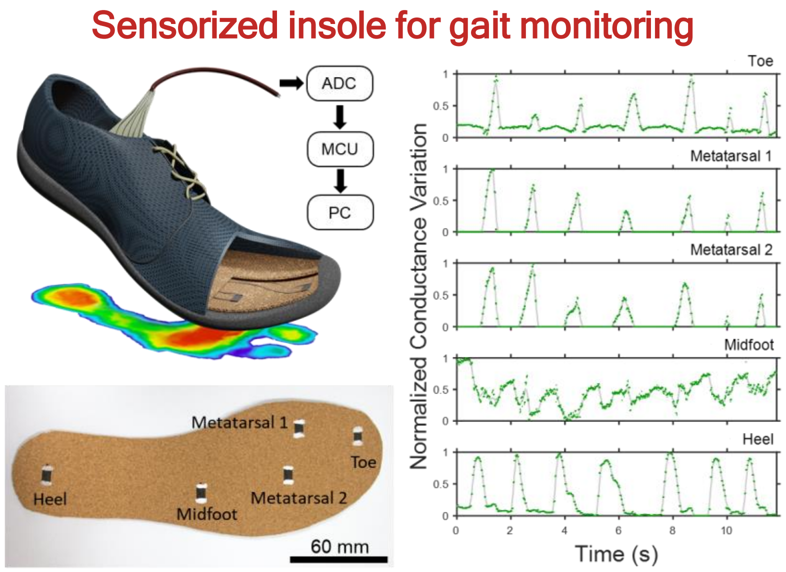
Cork **Paper**

LIG sensors on Cork

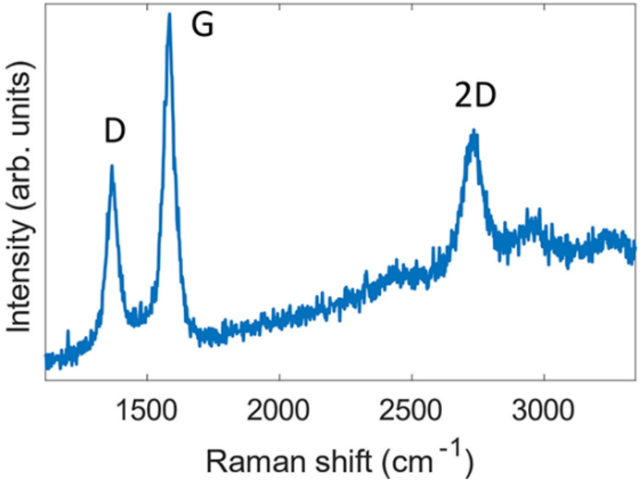




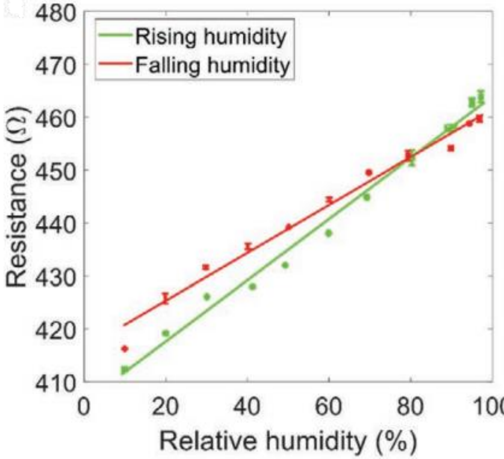




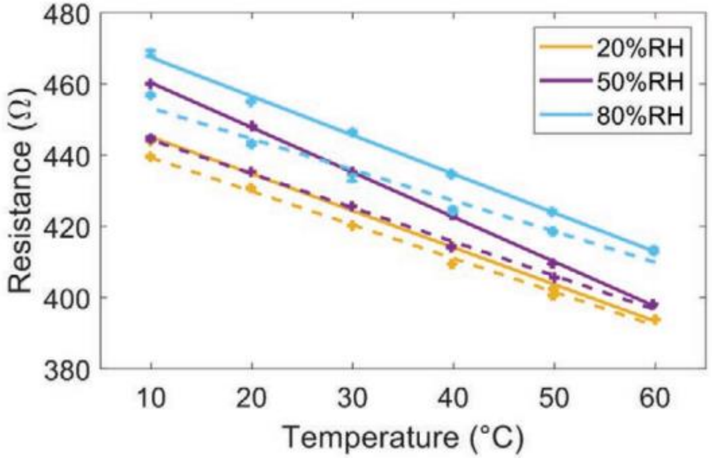
LIG sensors on Paper



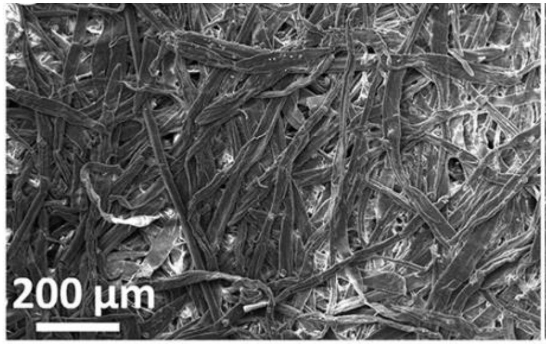
Humidity sensor



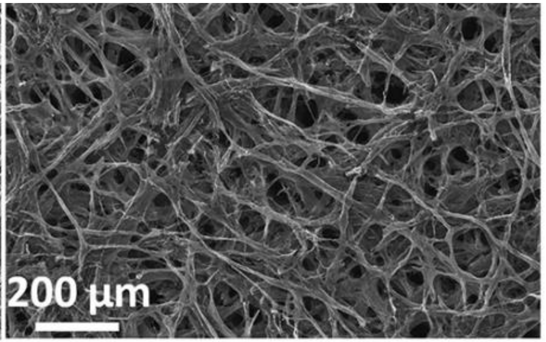
Temperature sensor



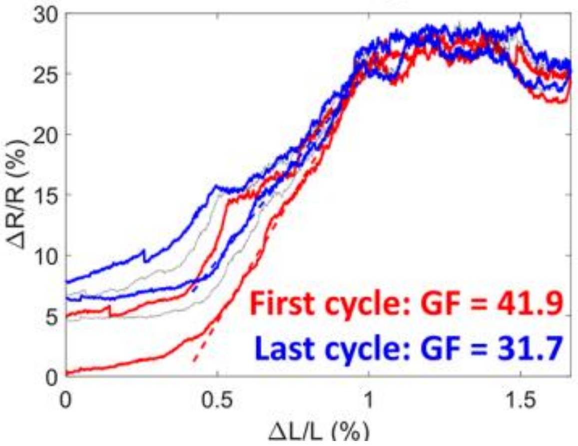
Paper



Paper LIG



Strain sensor



- Potential application in food monitoring in disposable packaging
- Sustainable way to feed data to the IoT

Questions?

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