

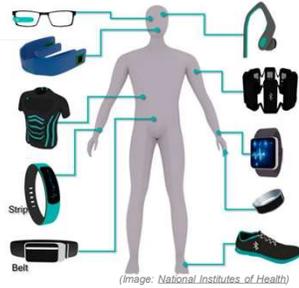
# 3D Printing Wearable Electronics for Low-cost Mobile Health Monitoring

Andy Wenyu Wang, Karim Ouaras, Patrick Stipp, Yan Yan Shery Huang  
The Nanoscience Center, Department of Engineering, University of Cambridge, CB3 0FF UK



## Wearable Electronics for Long-term Health Monitoring

Wearable electronics provide continuous reading of human health indexes of interest. Ideally, these devices should **accurately collect health data** while **maximizing wearing comfort**. In addition, wearable electronics should also allow **convenient customization** in a **low-cost** and **environmental-friendly** way.



### Functions & Requirements

- Long-term monitoring
- Multilatitude sensing
- Accurate sensing
- Wearing comfort



### Challenges for materials and fabrication routes

- Cost
- Sensitivity
- Customisation
- Environmental compatibility

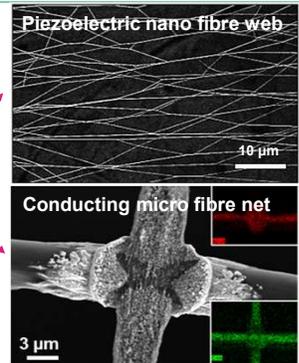
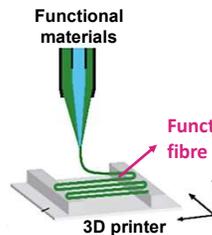
## 3D Printing Bio-inspired High-performance Sensors



Spider web is highly transparent, conformal, permissive and flexible, and can detect sound efficiently.

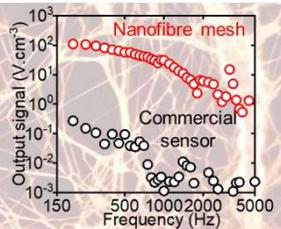


Inspired by spider net, we invented **3D printing** method to **produce electronic-functional materials into sensors** that can detect sound and moisture.



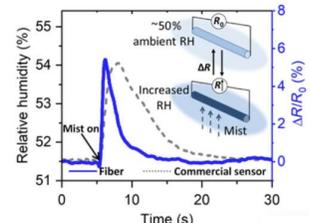
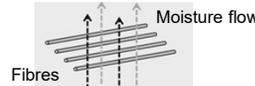
### Acoustic Sensor – broadband sensitive

- Nanofibre web harnesses sound sensing merit of spider web, enabling **high sensitivity across human hearing spectrum**.
- Produced with piezoelectric materials, allowing **self-powered signal output**.



### Moisture Sensor – accurate and breathable

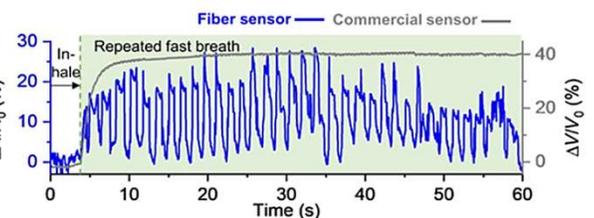
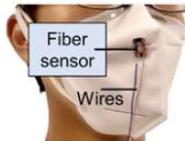
- Fibre web is permissive to moisture (breathable).
- Fibre resistance is proportional to humidity.



## 3D Printed Breath/cough Sensor – low-cost mass customisation

### Wearable Respiratory Sensor

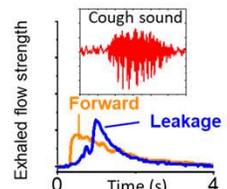
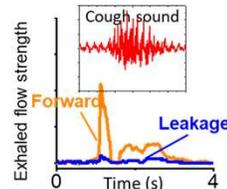
The 3D printed fibre sensor could track human breath based on the detection of moisture. Compared with commercial sensor, the **3D printed sensor is more sensitive to track fast dynamics of breath** (rapid breath during exercise). This is because the **micro-fibres allow fast moisture absorption and dissipate**.



### 3D Printed Breath Analyzer



The coin-size 3D printed breath analyzer could **identify the pattern of breath leakage through face coverings and detect cough sound**. We found most leakage from surgical masks comes from the front; while most leakage from N95 masks comes from the sides with tight fittings.



- 3D printed sensor allows **convenient customizable** design.
- Materials cost < **£0.5**.
- No need harsh solvent, high-temperature or electrical fields, being **environmentally-conscious and energy-saving**.
- Sensor material is biocompatible, and the whole sensor is **recyclable**.
- The cost of 3D printer is ~ £500, so people could **afford the machine for home use**.

### References:

- [1] Wang, W, et al. Small 16.28 (2020).
- [2] Wang, Wenyu, et al. Science Advances (2020).

### Contact:

Dr Andy Wang ww333@cam.ac.uk

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