

# Battery Free Smart Bandage

Investigators: Yi Li, John Tudor

Assisted by: Neil Grabham, Abiodun Komolafe

Smart Electronic Materials and Systems Research Group, Electronics and  
Computer Science, University of Southampton

October 2018 to April 2019

# Contents

- Smart bandage definition
- Radio Frequency Identification (RFID) technology
- Smart textiles
- Pathway to battery free smart bandage
- Conclusions and outcomes

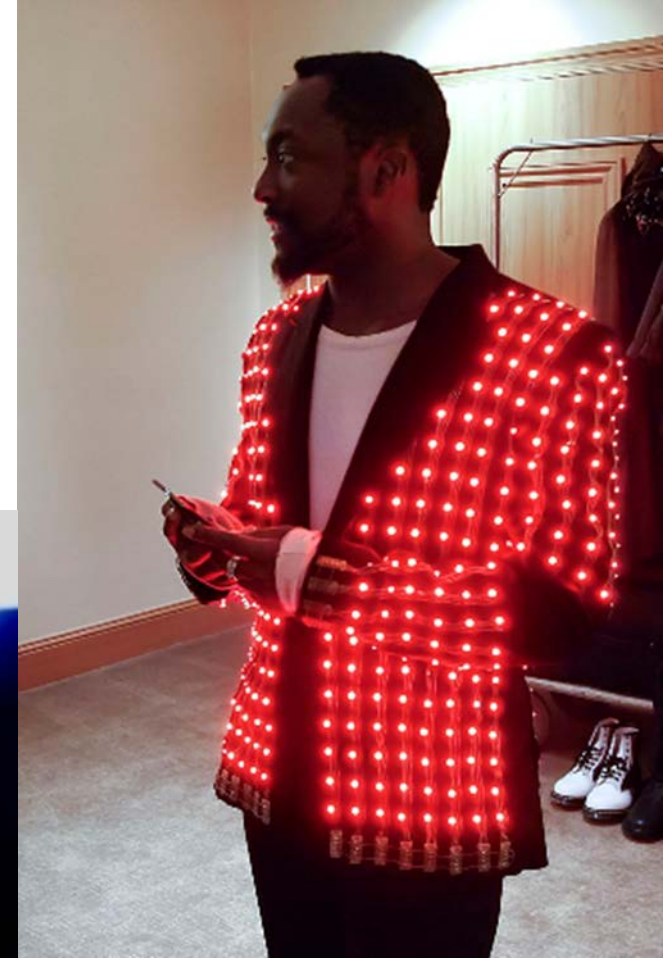
# What is a smart bandage?

- Currently healthcare relies on visual inspection of the wound healing process.
- Wound management integrated within a bandage can potentially save £b.
- A smart bandage is a bandage or plaster which has integrated electronic functionality.
- Electronic functionality monitors wound parameters such as wound temperature, humidity, pH, glucose, pulse and oxygen saturation (via oximetry).
  - Assessment of wound healing and any onset of infection.
- Ideally sensed data relayed wirelessly.
- Typically requires a battery
  - Finite lifetime, rigid, environmentally unfriendly

# Radio Frequency Identification Technology (RFID)

- RFID technology allows the transmission of power to the bandage from the RFID reader.
  - Used to wirelessly power the sensor(s) and associated electronics and wirelessly read the sensor data.
- 1) Ultra high frequency communication (UFC) technology (433, 860-960 MHz)
  - Antenna within bandage receives power.
  - 1 to 15 m range.
  - Multiple bandages read simultaneously.
  - Specialised expensive UHF reader required.
  - Hospital use.
- 2) Near field communication (NFC) technology (13.56 MHz).
  - Coil within bandage receives power.
  - 10 cm range.
  - Reader can be a mobile phone.
  - One bandage read at a time.
  - Home use.

# What are smart textiles?

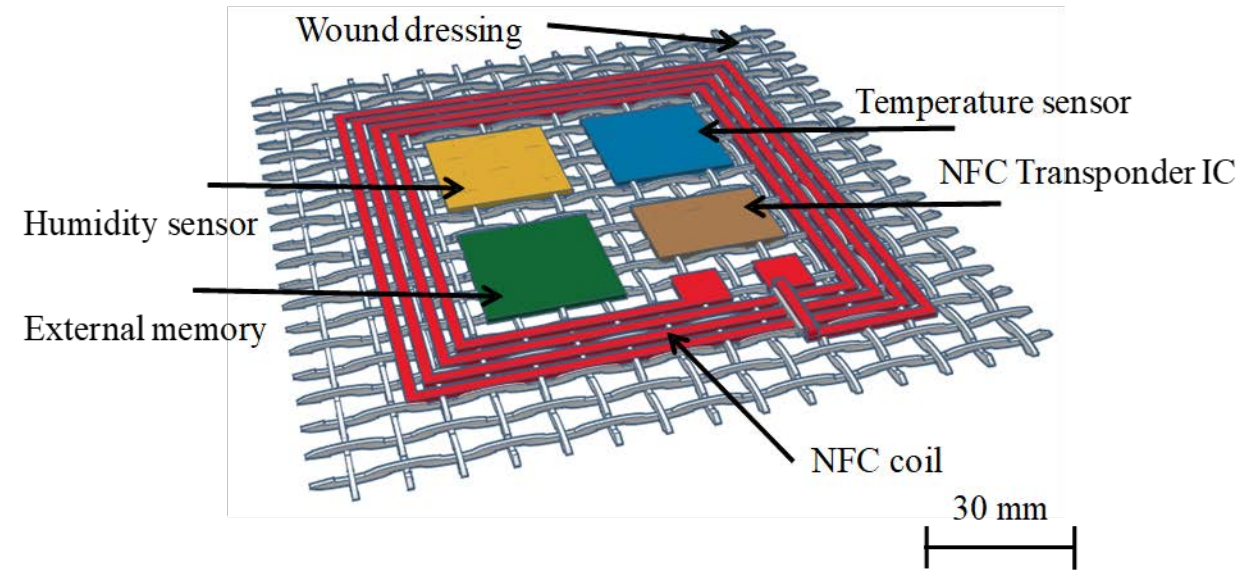
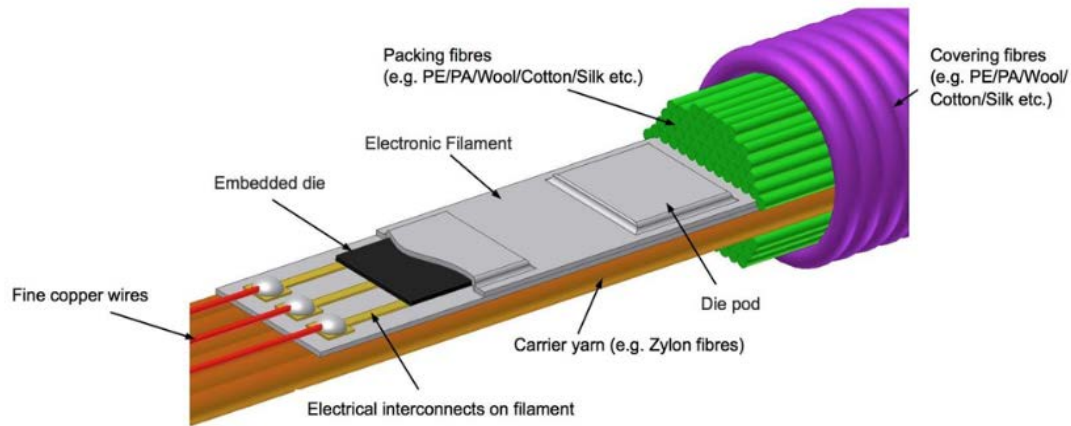


# Video: Electroluminescent display



# Pathway to Smart Bandage: realisation approach

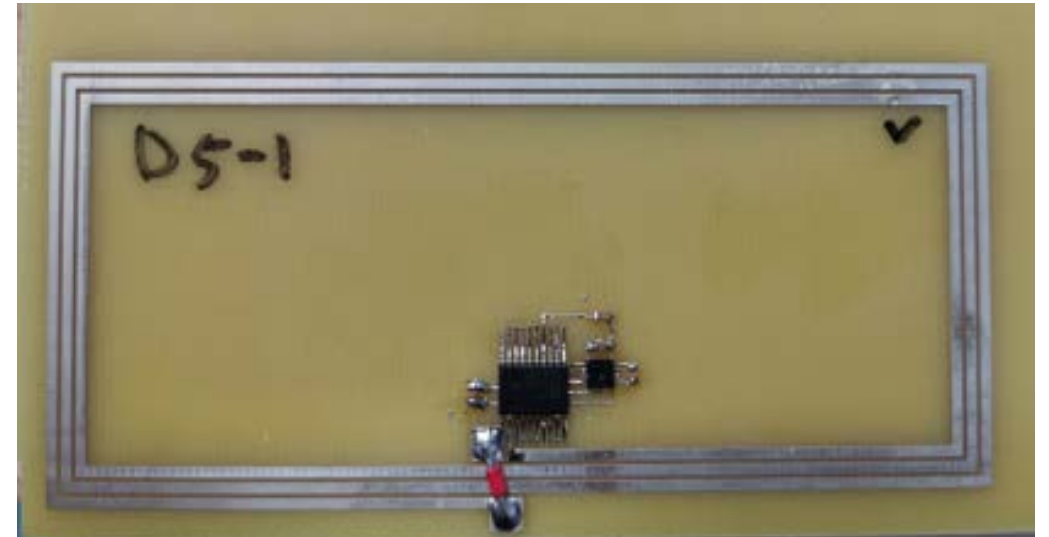
- Smart textiles can be achieved by weaving, embroidering or knitting functional yarns or by printing functional materials.





# Pathway to Smart Bandage: wireless temperature and humidity sensing based on NFC

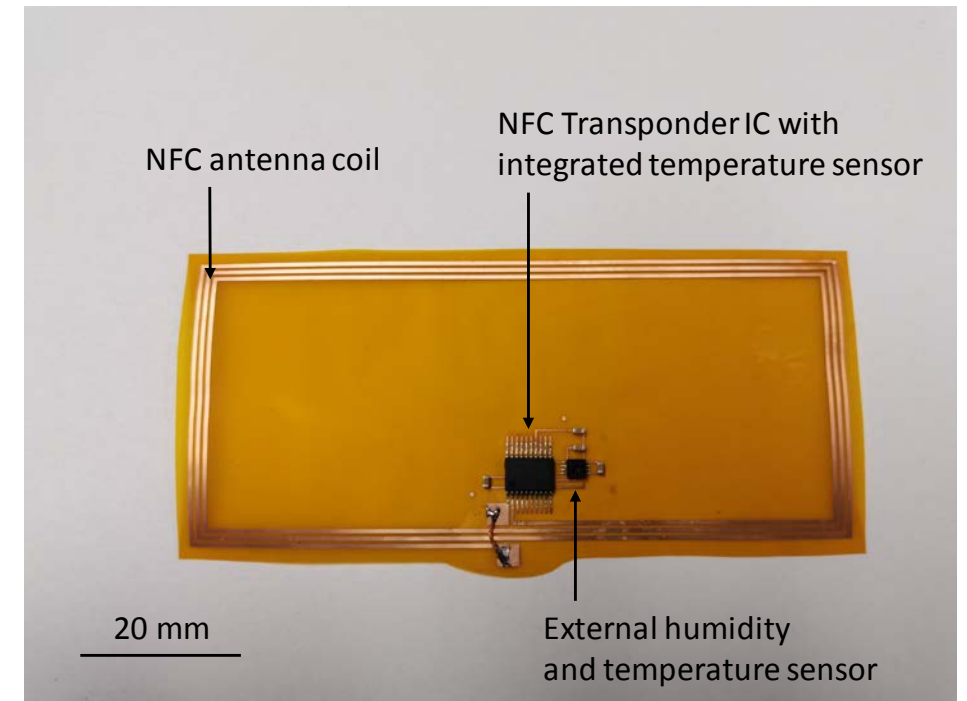
- Melexis NFC evaluation board with a compatible reader.
- Melexis transponder IC with internal temperature sensor specified.
- Antenna designed.
- Humidity and temperature sensor specified.
- First battery free smart bandage prototype fabricated on a milled PCB board.
  - Evaluation of a range of antenna designs and sensors.





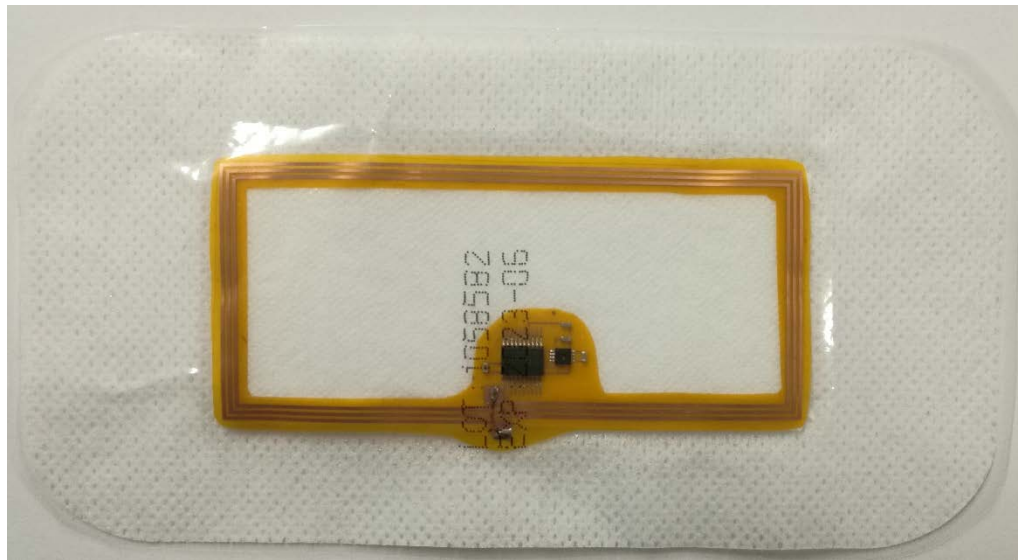
# Pathway to Smart Bandage: integration on flexible Kapton

- Flexible smart bandage then realised on Kapton (Polyimide) substrate using photolithography, etching and pick and place of components.
- Demonstrated temperature and humidity sensing with battery free operation.



# Pathway to Smart Bandage: integration in bandage

- The fabricated smart bandage on Kapton is attached to a conventional wound dressing
- Or enclosed in a standard textile pocket,
- Or stitched to any flexible surface.



# Conclusions

- Current status
  - Smart bandage fabricated on flexible Kapton.
  - Demonstrated NFC-based wireless temperature and humidity sensing without a battery.
  - Novelty is the passive flexible battery-less bandage system: all powering of sensing and data transmission is from the RFID remote station.
- Future
  - Further software development needed using Visual Basic/C# to generate a user interface and interpret the data from the transponder IC.
  - Increase the number of biomarkers which can be sensed.
  - Investigate UHF-based smart bandage to increase the detection range and incorporate simultaneous detection of multiple smart bandages.

# Outcomes

- Presented at Functional Electronic Textiles workshop on 16th May 2019 at Nottingham Trent University.
  - Attended by 50 industrialists alongside academic participants.
  - Including representatives of the e-Textiles network (<https://e-textiles-network.com/>) which is coordinated by members of the Smart Electronic Materials Group (including JT and YL) at the University of Southampton.
- Intern will be employed over summer 2019 to develop software interface.
- YL intends to apply for a 5 year Research Fellowship with the smart bandage research as either a demonstrator within it or as the key target application. Deadline Oct 2019.
- Journal paper targeting IEEE Transactions on Biomedical Circuits and Systems.