School of Electronics and Computer Science

EFFECT OF BANDAGE MATERIALS ON EPIDERMAL ANTENNA

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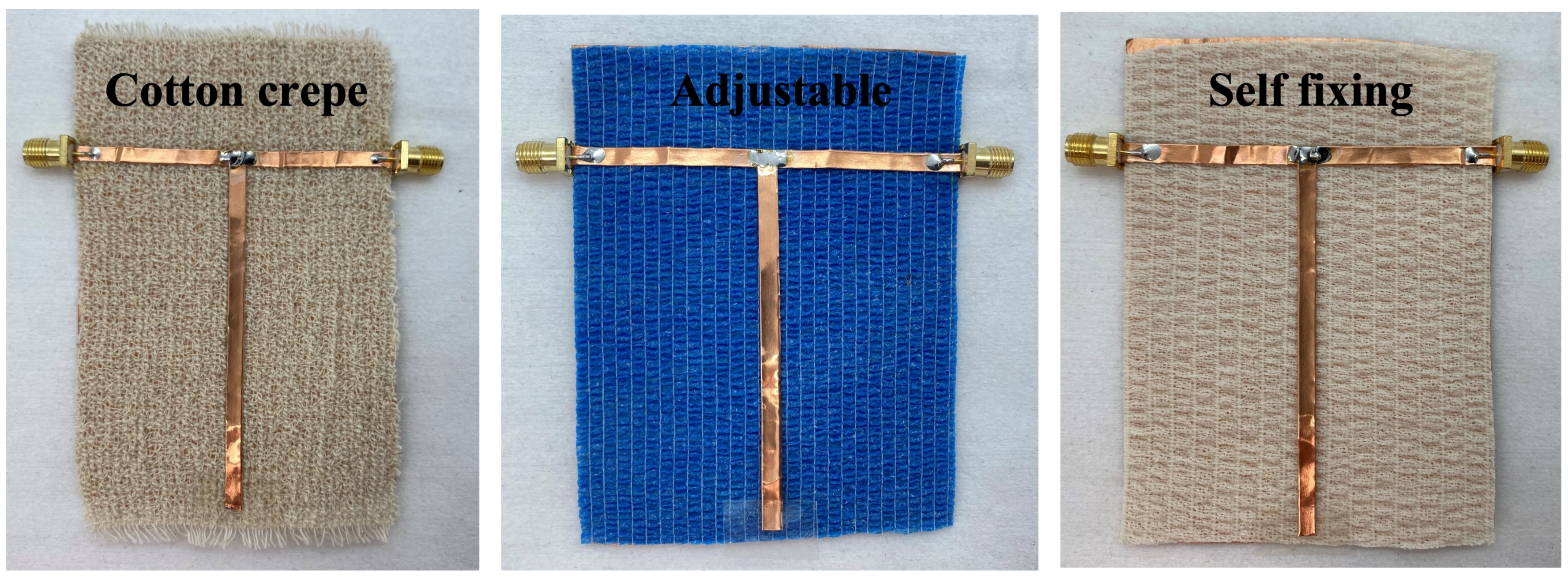
Introduction

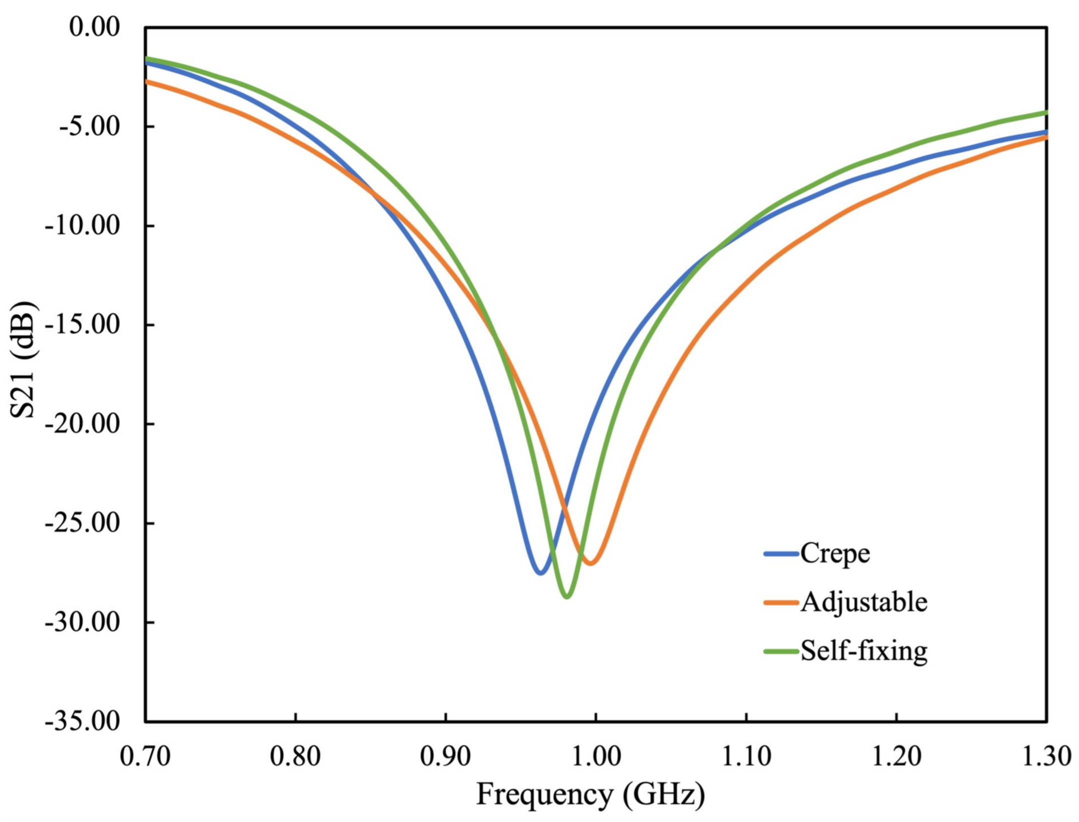
A smart bandage uses different types of sensors to monitor wound-related parameters such as temperature, moisture level and pH level in chronic wound care and management. The smart bandage requires a power source and a means for wireless data transmission. An antenna design is a crucial part of designing wireless and battery-free smart wound dressing as it can be used to transmit data and also for harvesting RF energy. Therefore, in this study, we propose an all-fabric epidermal antenna operating at 915 MHz for wearable applications. The study also explores the effect of different types of bandages on the resonance frequency of the epidermal antenna.

Dielectric Constant Characterization

- First, the T-resonator method is used to determine the dielectric properties of the bandage material
- Three types of bandage materials are investigated:
  - Cotton crepe bandage made of cotton
  - Self-fixing cohesive support bandage made of cotton/elastane with latex
  - Adjustable cohesive bandage made of polypropylene and elastane
- Measured results show that the relative permittivity of the cotton crepe bandage and the self-fixing bandage is 1.2 while the adjustable bandage has a relative permittivity of 1.17



T-resonator designs for determining the relative permittivity of the bandage material

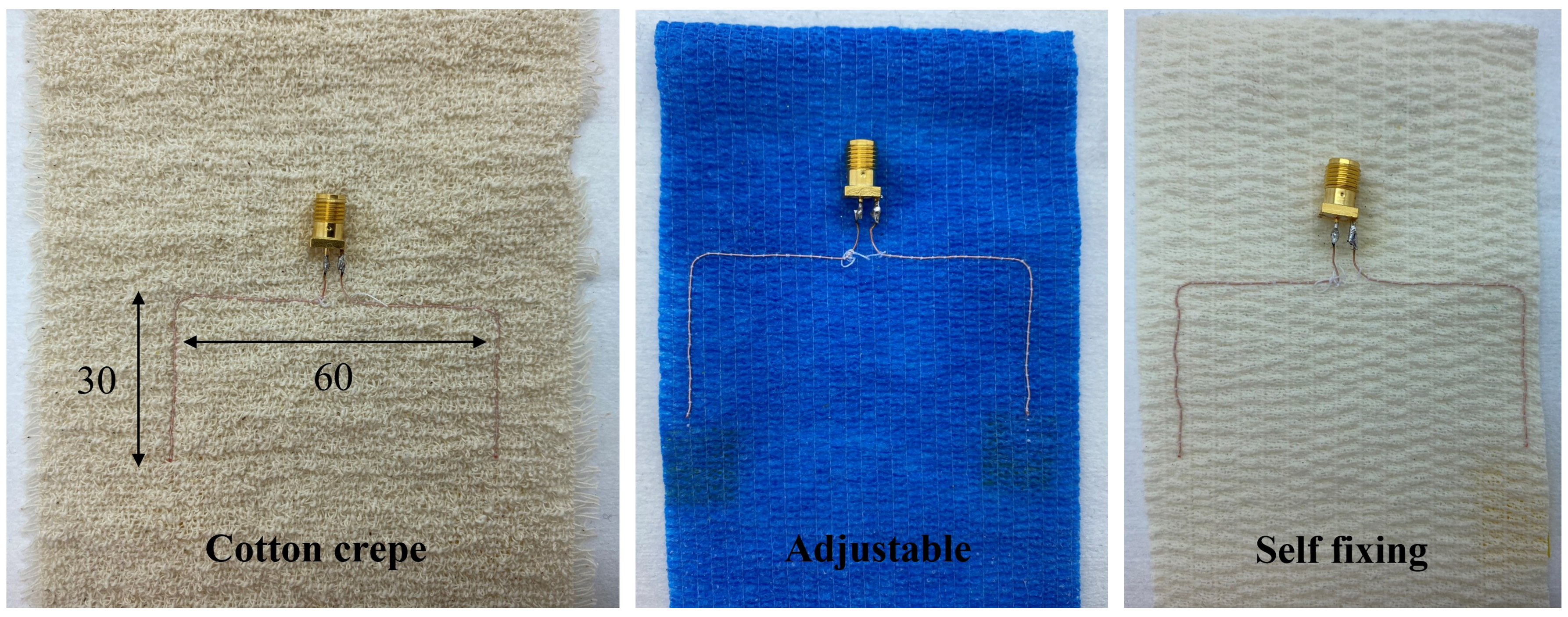


Bandage	Permittivity
Cotton crepe	1.214
Adjustable	1.179
Self-fixing	1.219

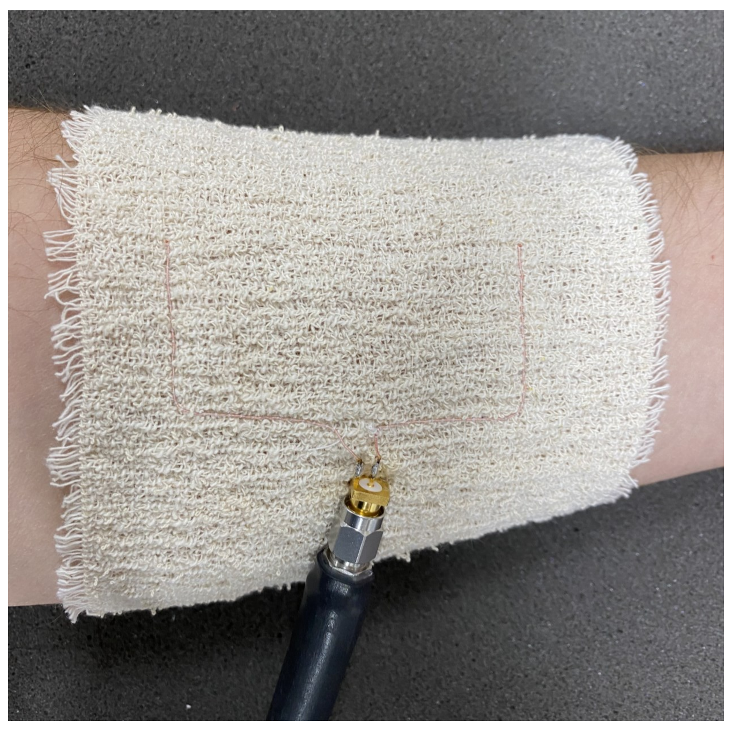
Measured frequency response of the microstrip T-resonators and calculated relative permittivity of the bandage material

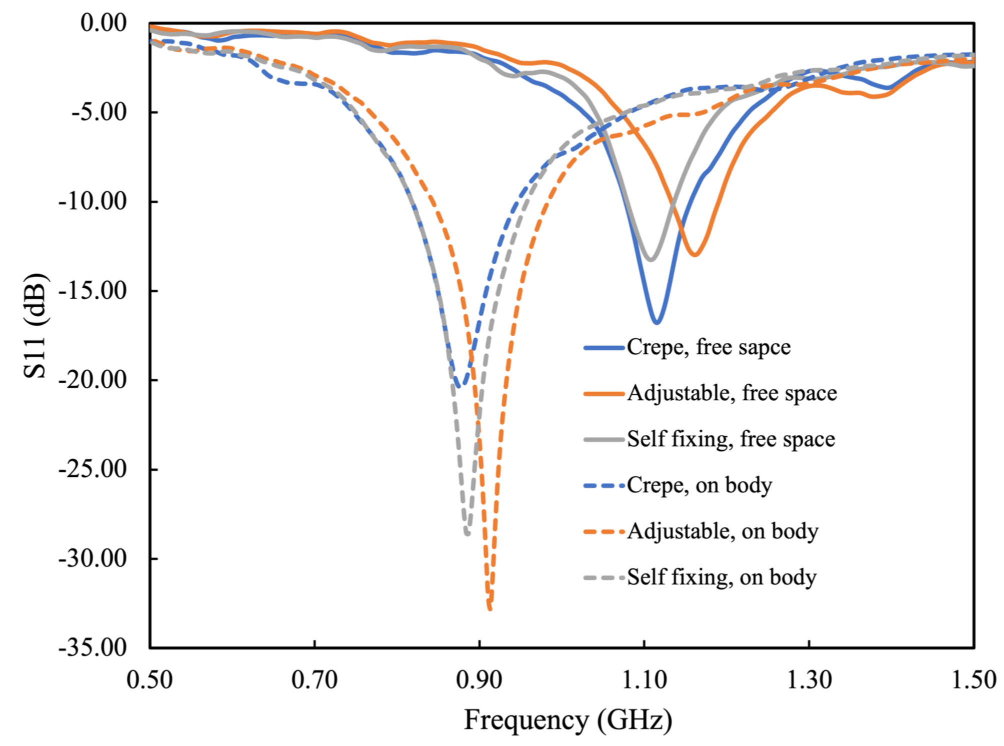
Antenna Design

- Three identical dipole antennas are designed
- The antennas are made by embordering silk-coated Litz wires with a diameter of 1.44 mm into a cotton crepe, self-fixing and adjustable cohesive bandage
- And calibrated vector network analyzer was used to measure the S_{11} of the antenna in free space and on the body
- Measured S_{11} shows that the antennas are well-matched (S_{11} > -10 dB**)** at 1.1 GHz in free space
- The antenna resonance frequency shift to a lower frequency band in the presence of the body



Dipole antennas fabricated on different types of bandages (dimensions in mm)

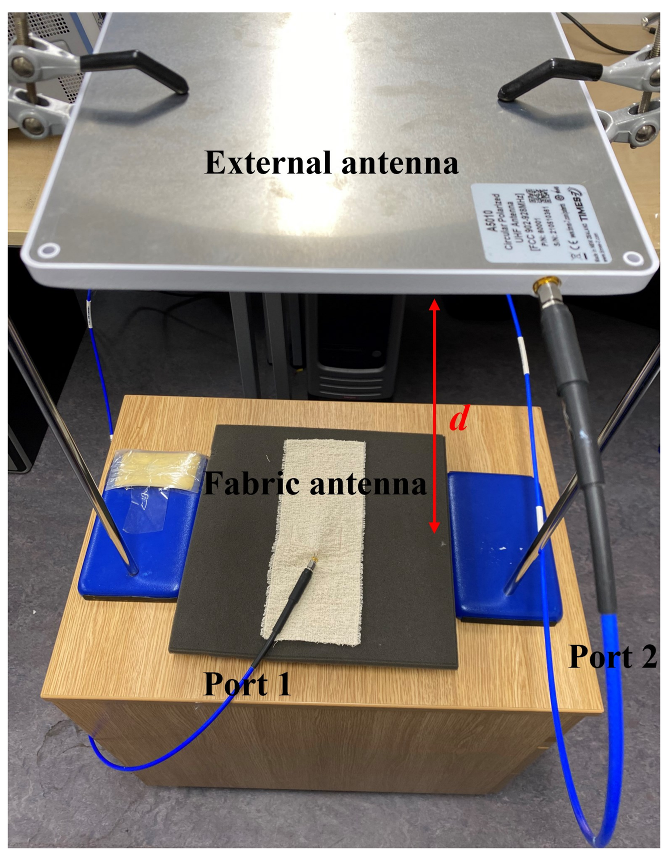


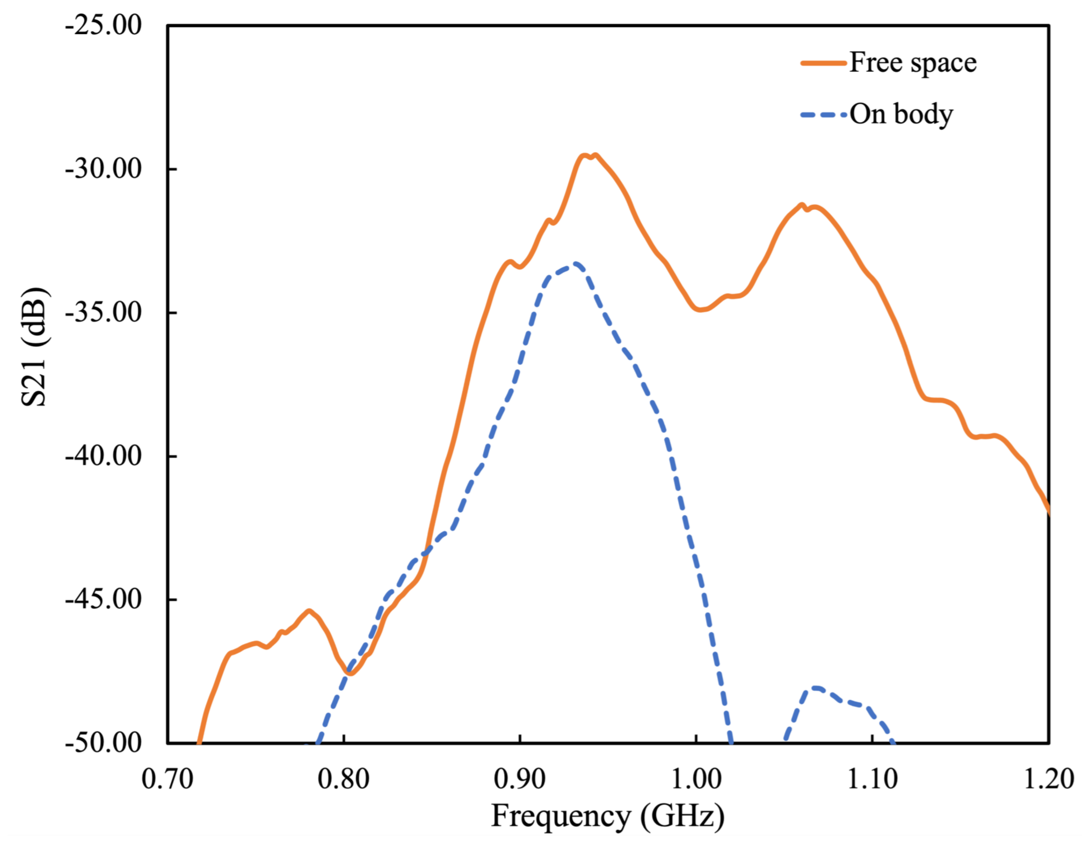


Antenna mounted on the human arm and measured reflection, S_{11}, of the antennas in free space and on the body

Transmission Coefficient

- The results show that the transmission coefficient, S_{21}, is about -30 dB in free space and -35 dB when mounted on the body
- This shows that for a 30 dBm RF input power, at least -5 dBm will be received by the receiver antenna, indicating that the antenna is suitable for RF power harvesting over a short distance





Experimental setup for measuring transmission coefficient, S_{21}, and measured transmission coefficient, S_{21}, between proposed fabric antenna and external antenna

Conclusions

- All-fabric epidermal antenna fabricated on fabric bandages is demonstrated
- The measured results show that the different types of bandages have no significant effect on the antenna resonance frequency
- Transmission losses of the antenna is -35 dB in the presence of the human tissue which indicates that at least -5 dBm will be received by the receiver for the input power of 30 dBm
- The antenna is lightweight, easy to fabricate and comfortable to the body and therefore, can be used for designing wireless and battery-free smart bandages

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