# SUPPLEMENTARY INFORMATION

# Real-time Humidity Sensor Based on Microwave Resonator Coupled with PEDOT:PSS Conducting Polymer Film

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## 1. Signal level coupling to the resonator

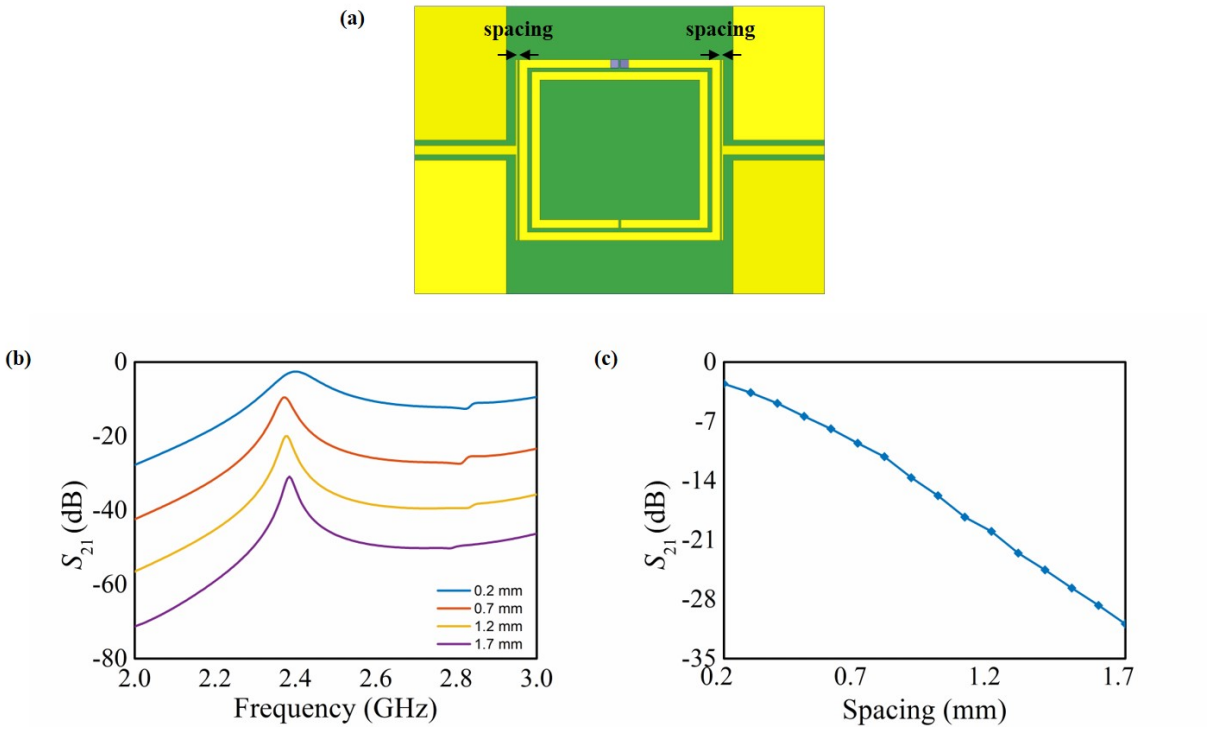


Figure S1. (a) The spacing between the signal line and the resonator. (b) Transmission coefficient of the resonator versus spacing (from 0.2 mm to 0.5 mm intervals). (c) Transmission coefficient of the resonator versus spacing (from 0.2mm to 0.1 mm intervals) at the resonance frequency.

## 2. Morphologies of the deposited PEDOT:PSS

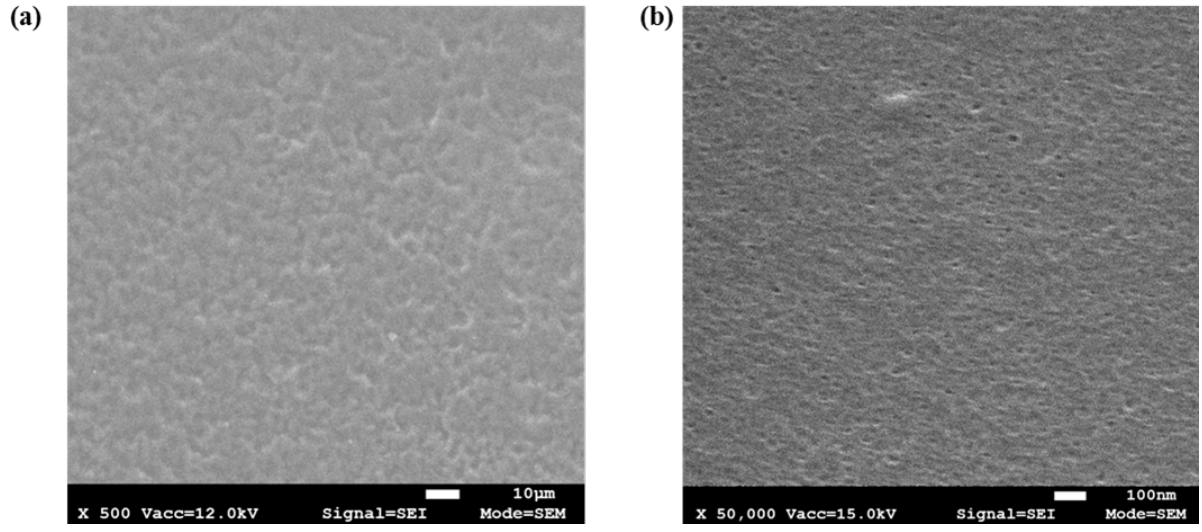


Figure S2. SEM images of the deposited film (a) Working distance = 8mm, acceleration voltage = 12.0 kV, magnification of 500. (b) Working distance = 8mm, acceleration voltage = 15.0 kV, magnification of 50,000.

## 3. XPS survey spectra of deposited PEDOT:PSS film

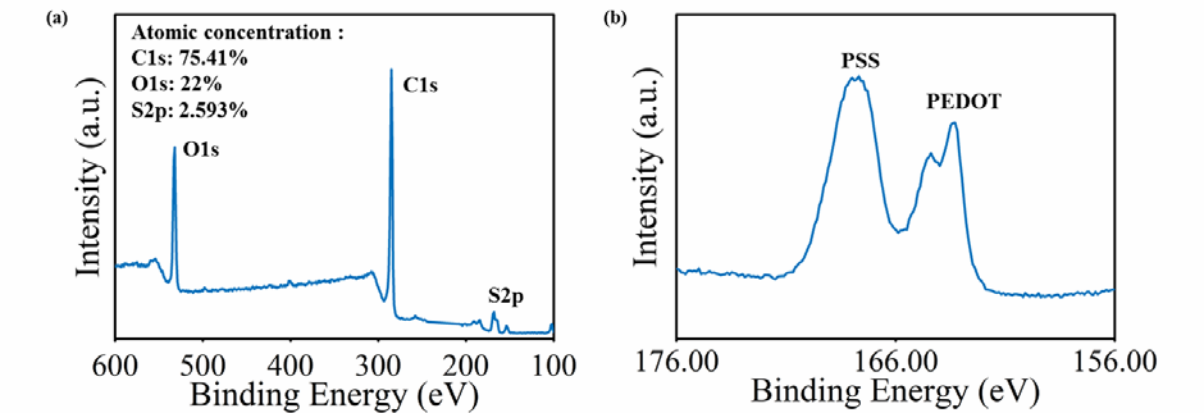


Figure S3 XPS spectra of deposited PEDOT:PSS film: (a) XPS general scan (b) Sulphur S(2p) (PEDOT = 163.4, 164.4 eV, PSS = 167.7 eV).

## 4. Verifying microwave characteristics of PEDOT:PSS[1]

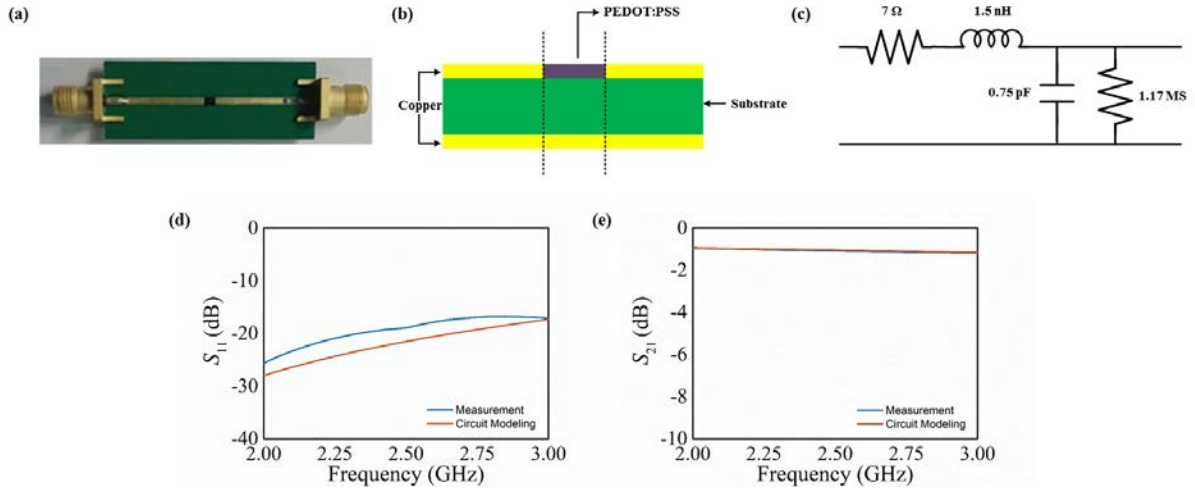


Figure S4. (a) The fabricated sample for verifying the microwave characteristics of PEDOT:PSS. (b) Side view of PEDOT:PSS-doped transmission line. (c) Circuit modelling of PEDOT:PSS-doped transmission line. (d) Reflection coefficients of measured and modelled PEDOT:PSS-doped transmission line. (e) Transmission coefficients of measured and modelled PEDOT:PSS-doped transmission line.

## 5. Comparison of RH sensors based on microwave components

Table S1. Comparison of RH sensors based on microwave components

| Component | Sensing Principle | RH Range | Sensing material | Sensitivity | Repeatability | Response Time | Ref. |
|---|---|---|---|---|---|---|---|
| Oscillator | Frequency shift | 0-40% | Polyimide | 5 kHz/RH | X | 68 sec | [2] |
| Slotline ring resonator | Power level, Frequency shift | 30-90% | Polyimide | 4.95 mdB/RH<br>181 kHz/RH | X | X | [3] |
| Antenna | | | | 5.50 mdB/RH<br>-108 kHz/RH | | | |
| RFID tag | Frequency shift | 25-90% | Polyimide | 108 kHz/RH | X | X | [4] |
| RFID tag | Frequency shift | 11.3-100% | Kapton HN | 171.4 kHz/RH | X | X | [5] |
| Stepped impedance resonator | Frequency shift | 65-80% | Kapton HN Polyimide | 200 kHz/RH | X | X | [6] |
| H-slot antenna | Power level | 50-100% | PEDOT:PSS | 0.2 dB/RH | O | X | [7] |
| Substrate integrated resonator | Frequency shift | 0-80% | X | 101 kHz/RH | X | X | [8] |
| | | | | 9.35 kHz/RH | | | |
| Double split-ring resonator | Power level, Frequency shift | 5-80% | PEDOT:PSS | 2.4 mdB/RH<br>0.47 MHz/RH | O | < 0.5 Sec | This work |

References


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