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MEMS Moisture Sensor for Concrete Health Monitoring

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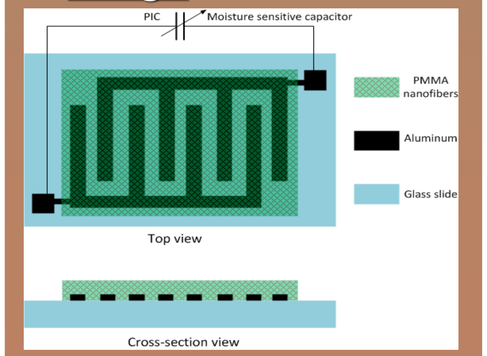
Introduction

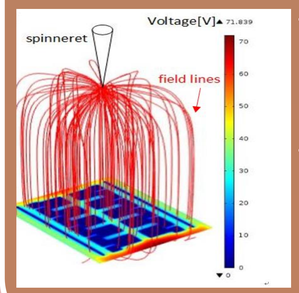
Micro-Electro-Mechanical Systems (MEMS) moisture sensor provides an efficient and cost-effective health monitoring method for engineers to detect dynamic change of moisture inside concrete.

Objectives

- Build a capability of monitoring relative humidity (RH%) inside concrete at low cost.
- Achieve fast response (< 10s) and high sensitivity.
- Realize cost-effective fabrication

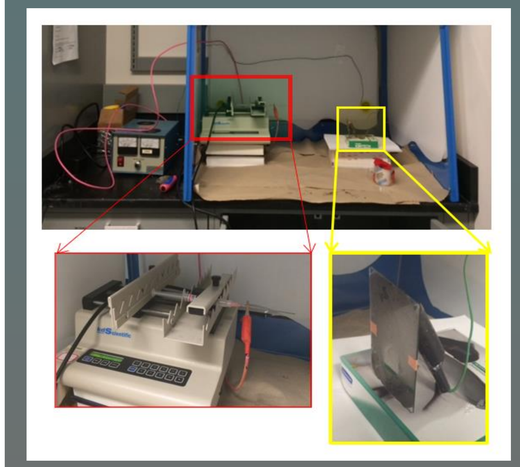
Design



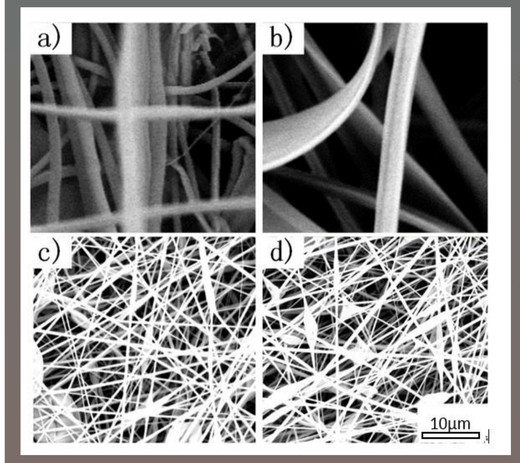


- **Planar interdigitated capacitor structure**
- **Electrospinning technology to fabricate moisture-sensitive nanofibers**

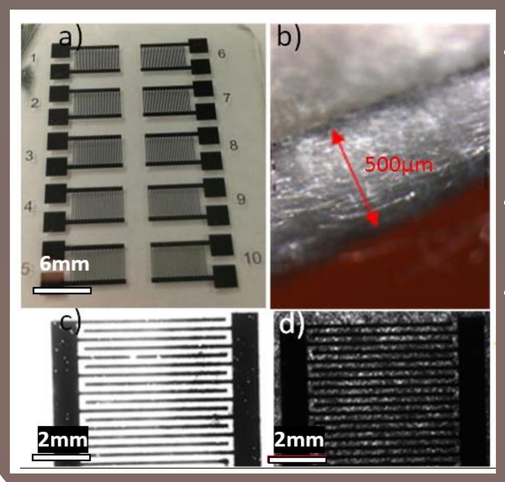
Results - Nanofabrication



- Changeable high voltage power
- Programmable syringe pump
- Adjustable deposition distance

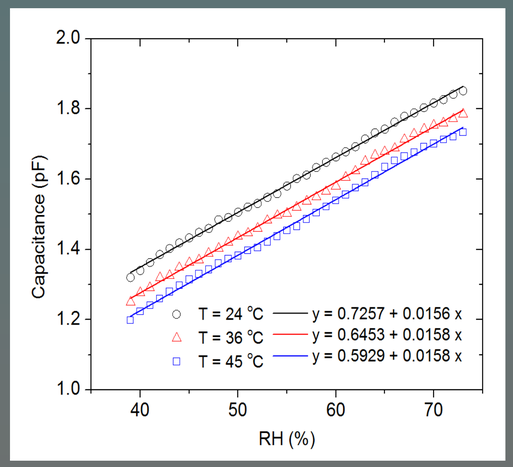


- Different shapes of fibers due to concentration:
  a) Microfibers
  b) Micro-belts
  c) Nanofibers
- Porous structure of constructed 3D PMMA fiber mat

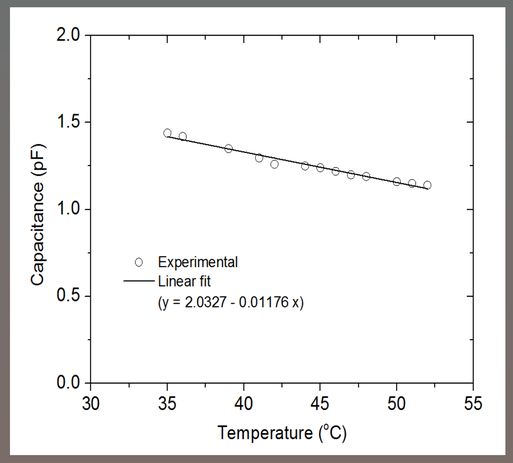


- Ten devices fabricated in the same glass substrate
- Multiple layers of nanofibers
- Moisture-sensitive PMMA nanofibers cover the planar microelectrodes

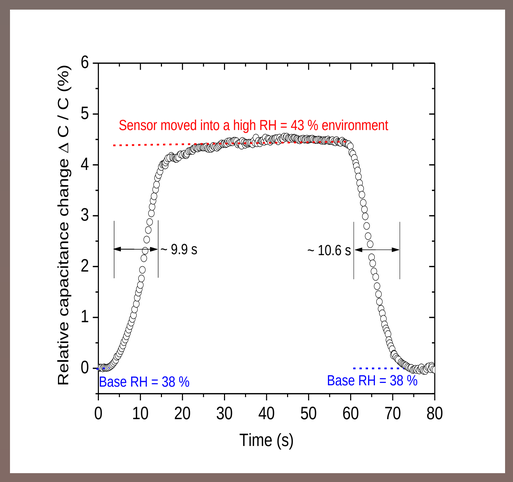
Results - Sensor Characterization



- Capacitance change reflects relative humidity change
- Linear relationship between capacitance change and relative humidity
- High sensitivity achieved



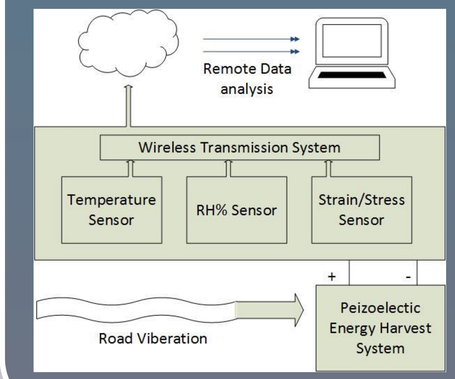
- The sensor is temperature dependent
- Be able to calculate a real moisture level in a given temperature point



- Fast response achieved (~10 s)
- Output signal is stable in a given humidity environment
- Reversible and repeatable humidity measurement

Future Work

- Three in one device: temperature sensor, RH% sensor and strain/ stress sensor
- Wireless data transmission for real time data acquisition and analysis
- Use piezoelectric material to build a mechanical oscillation energy harvesting system as a power source.



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Acknowledgements

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