

# Chipless, Passive, Multiplexed Wireless Sensors from Engineered Composites



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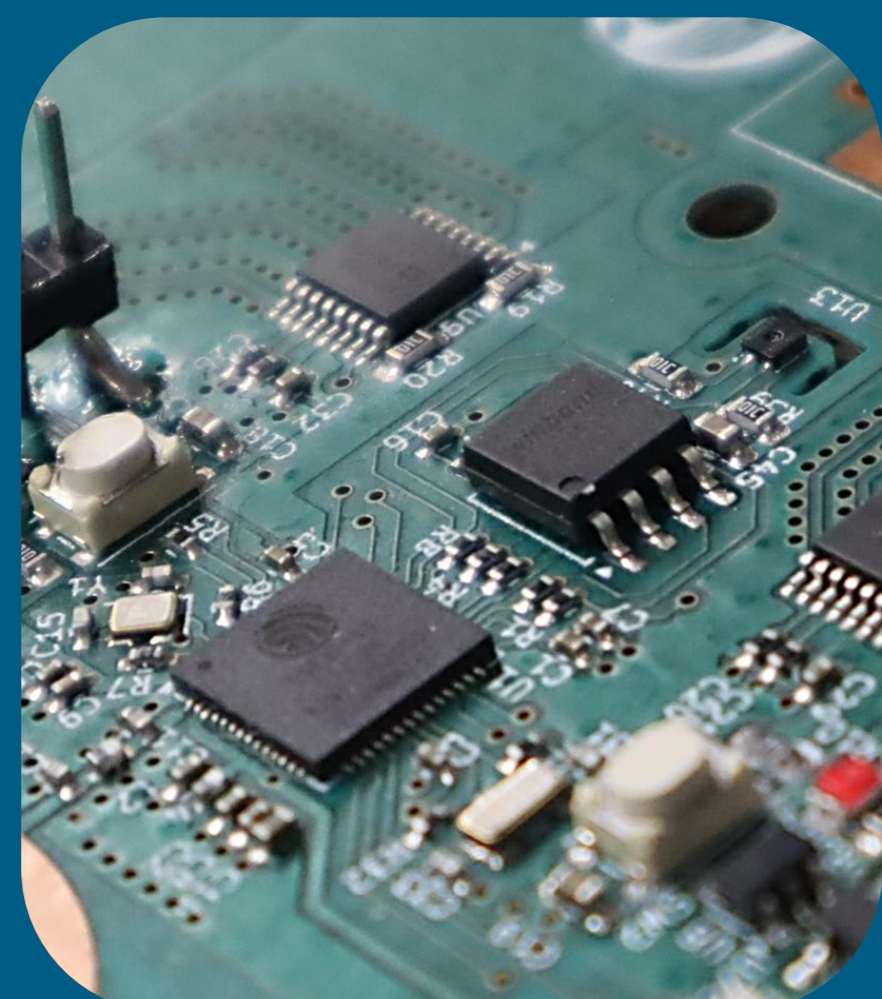
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## Environmental Sensors and Internet of Things (IoT) Devices

50 billion connected IoT sensors deployed by 2030.

Environmental and economic implications with demand for semiconductors and chips.

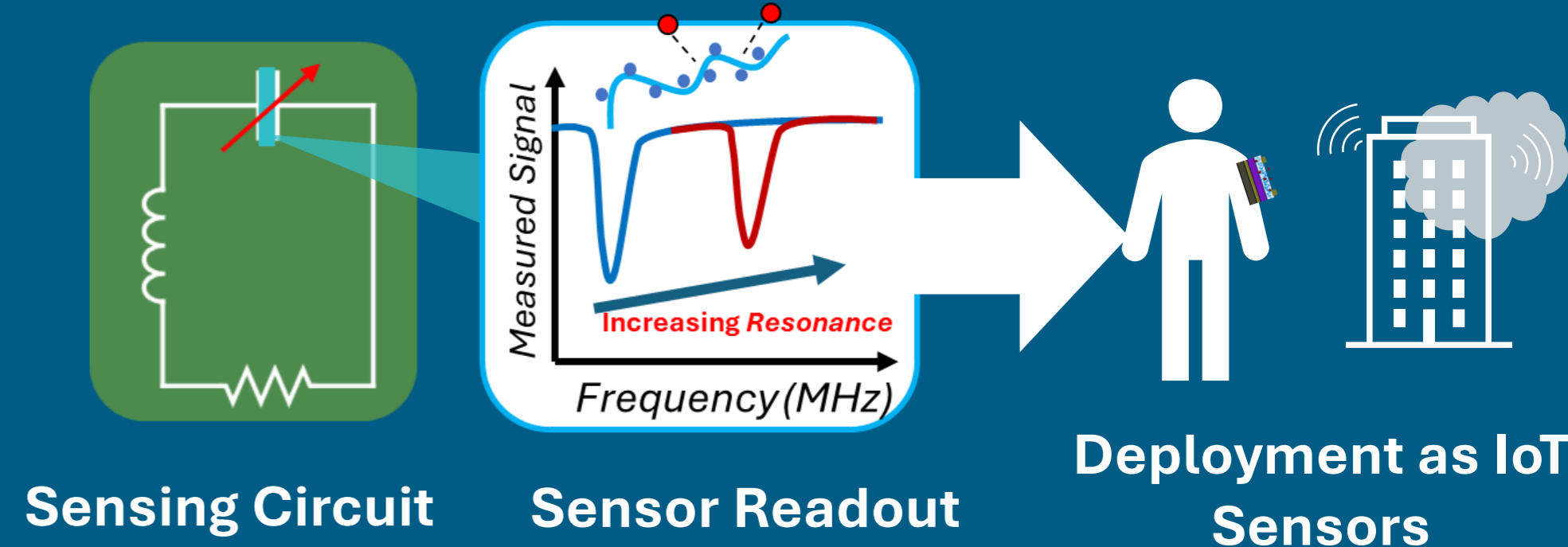
Traditional sensors have resolution limits due to measurement at single frequency.



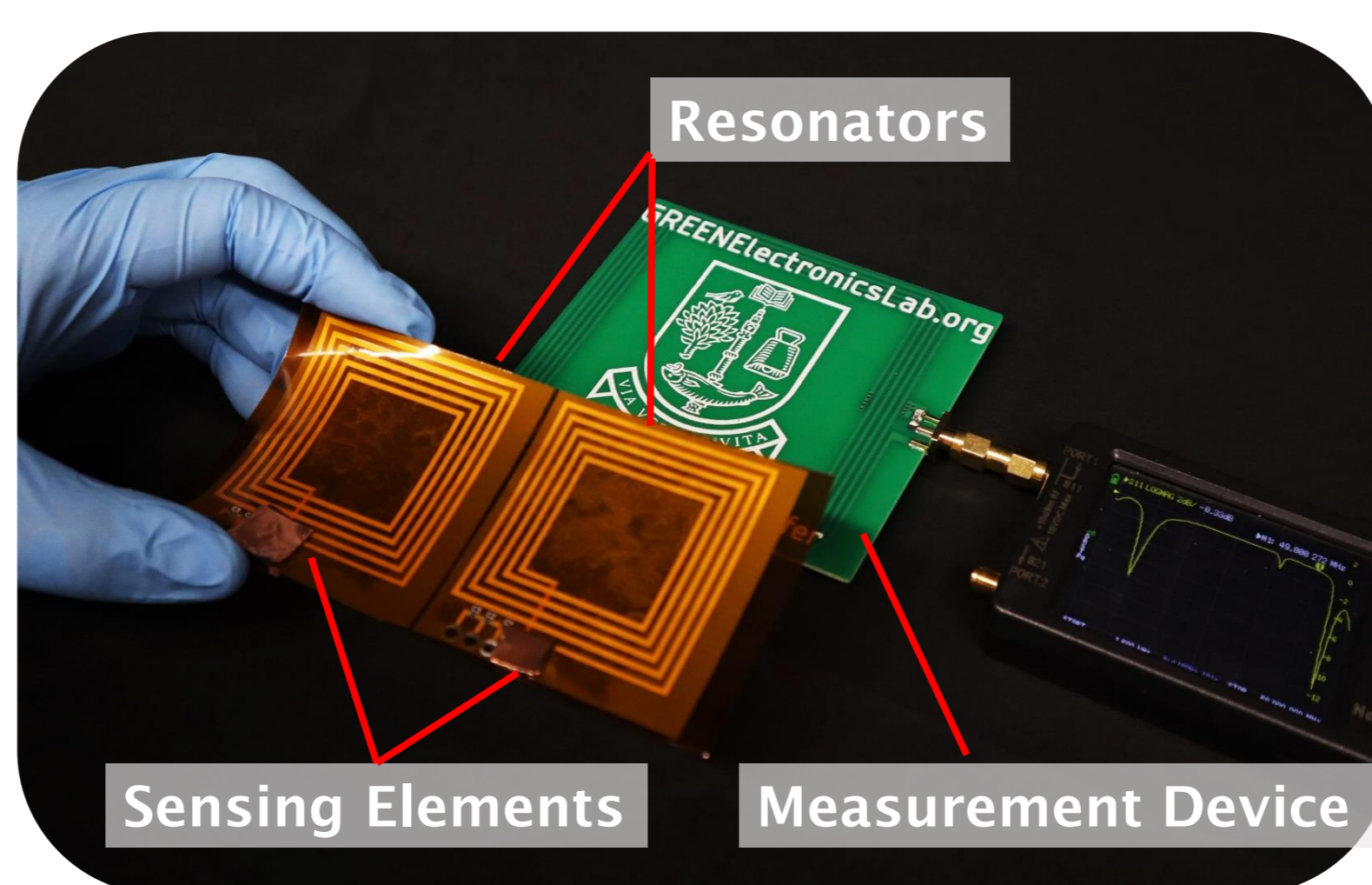
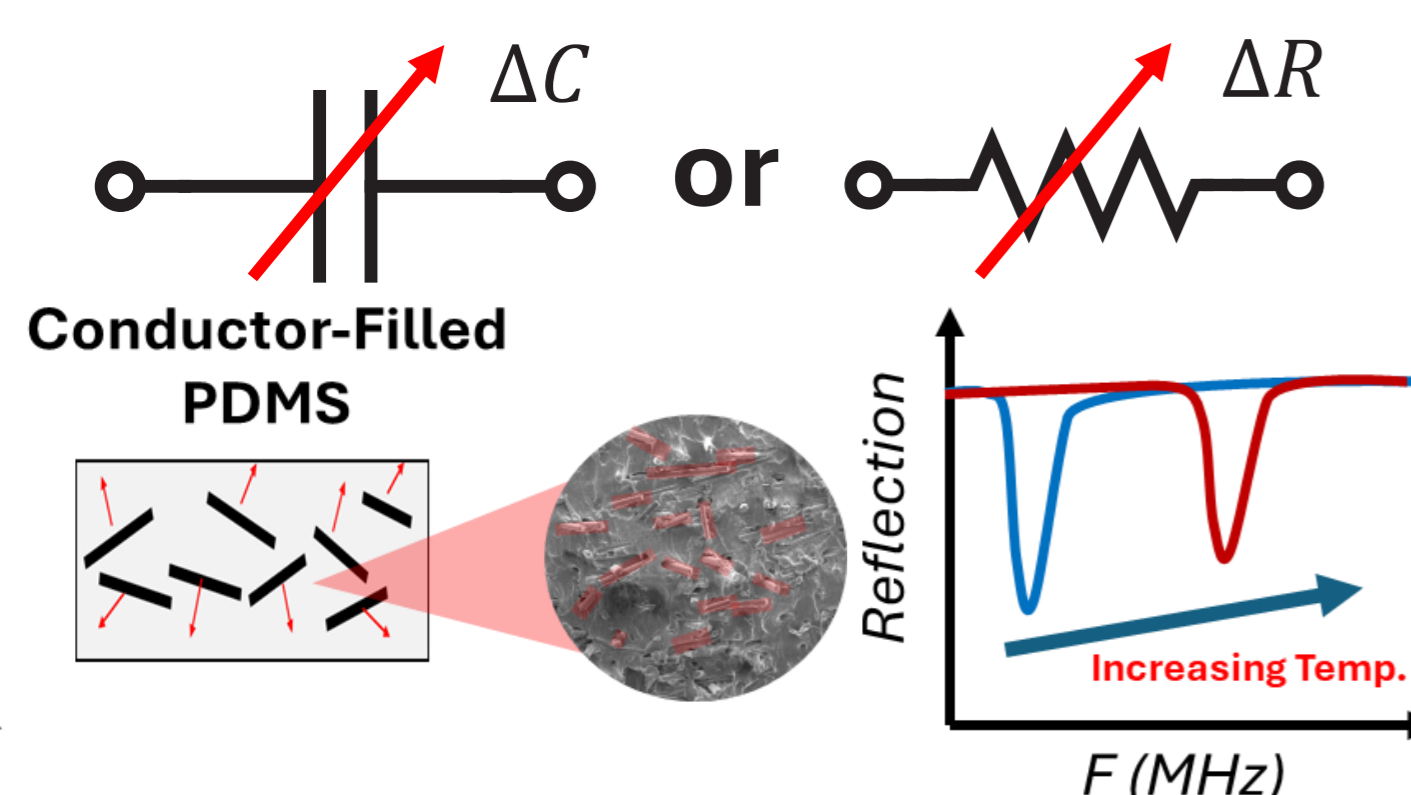
## Electromagnetic Sensing

Electromagnetic (EM) measurements enable chipless readout of material properties at thousands of frequencies simultaneously unlocking larger sensing range.

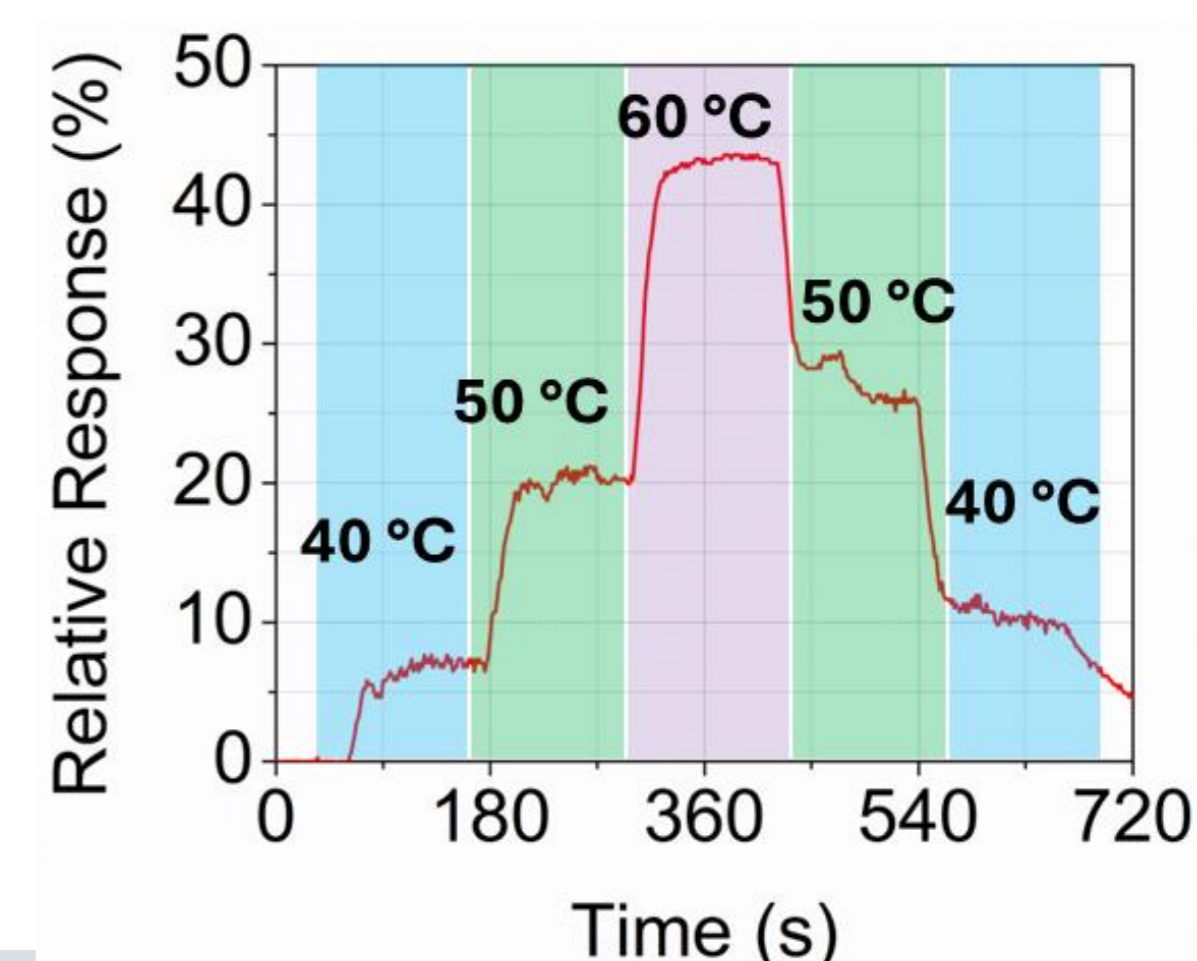
Functional materials will enable chipless environmental sensing with portable reader and sensors costing < £1 ea.



Change in material properties tunes circuit resistance (R) or capacitance (C).



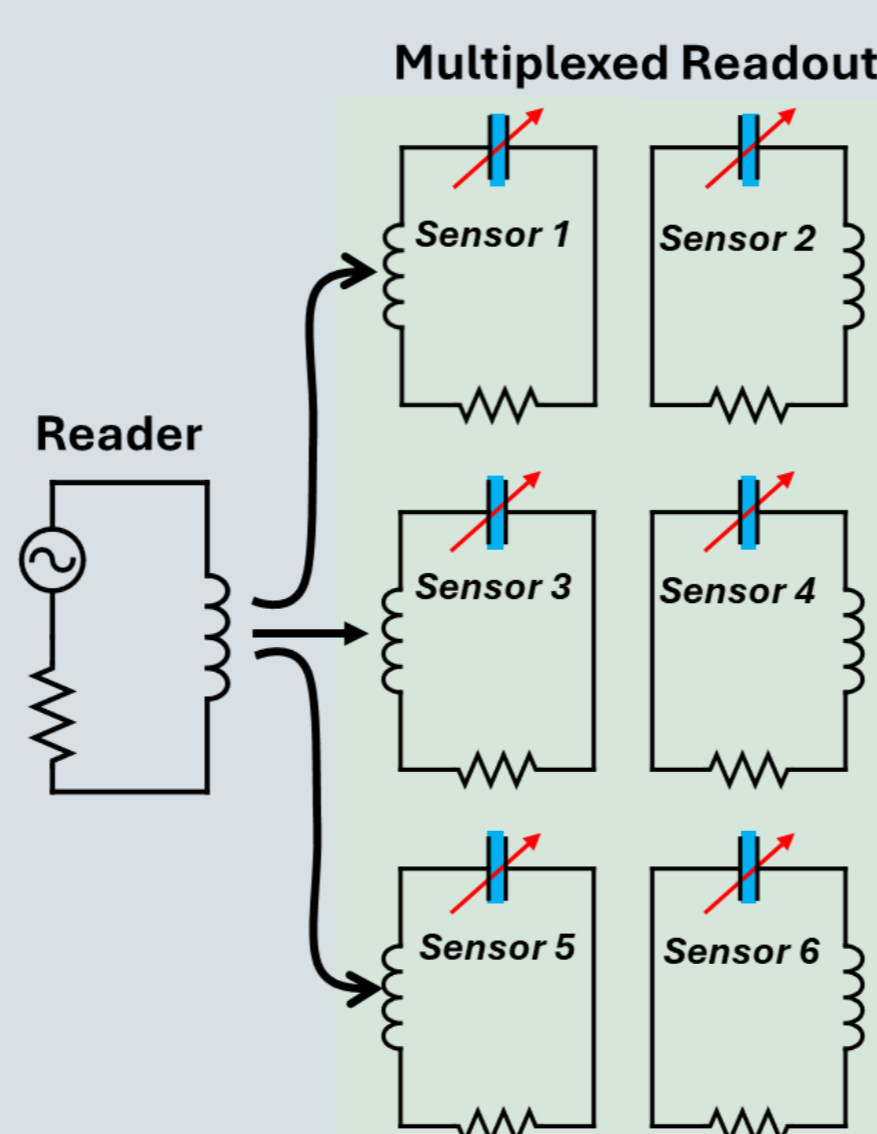
Dynamic, highly-sensitive readout



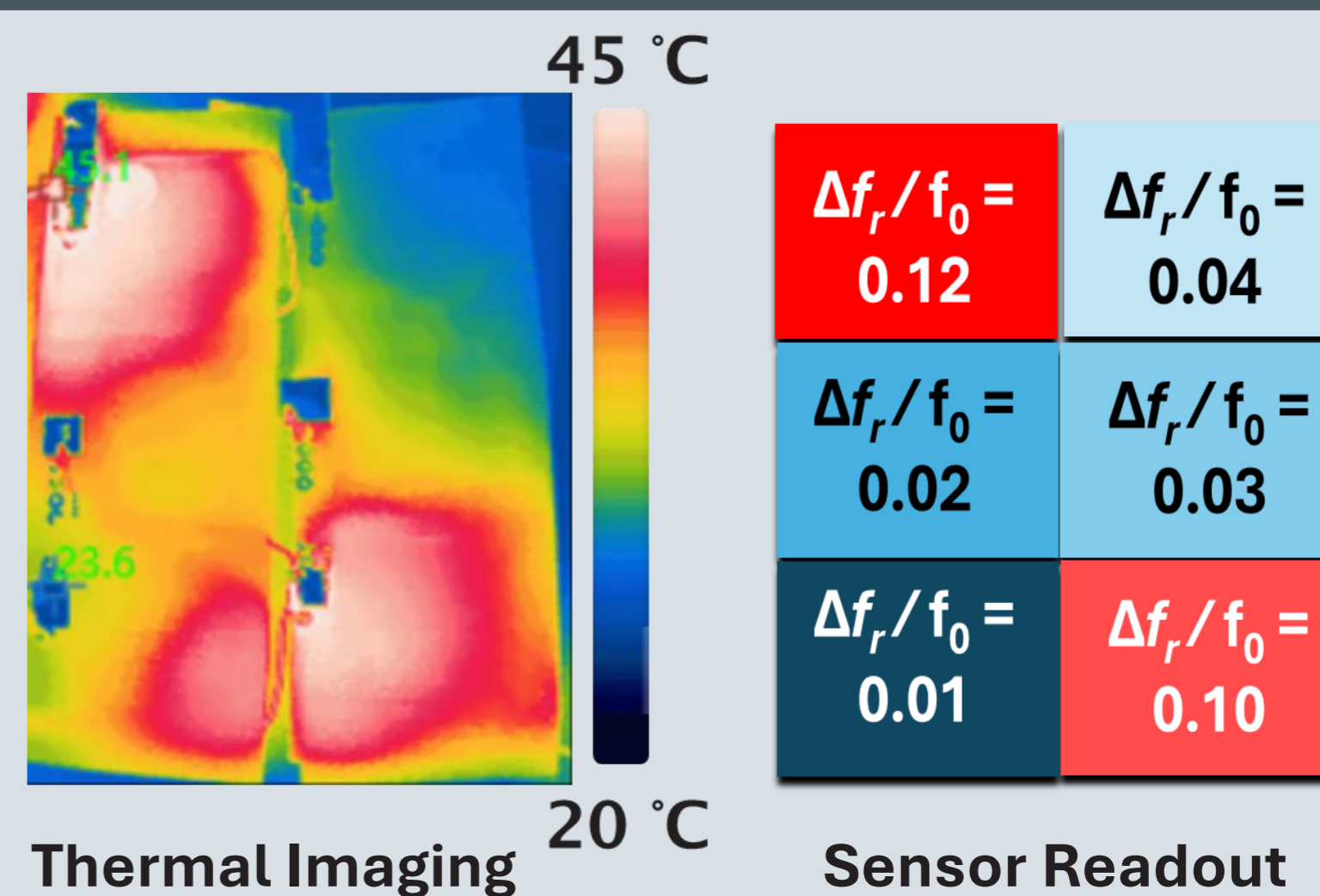
## Multiplexing and Spatial Detection

Multiplexing chipless sensors enables multiple measurands to be read simultaneously

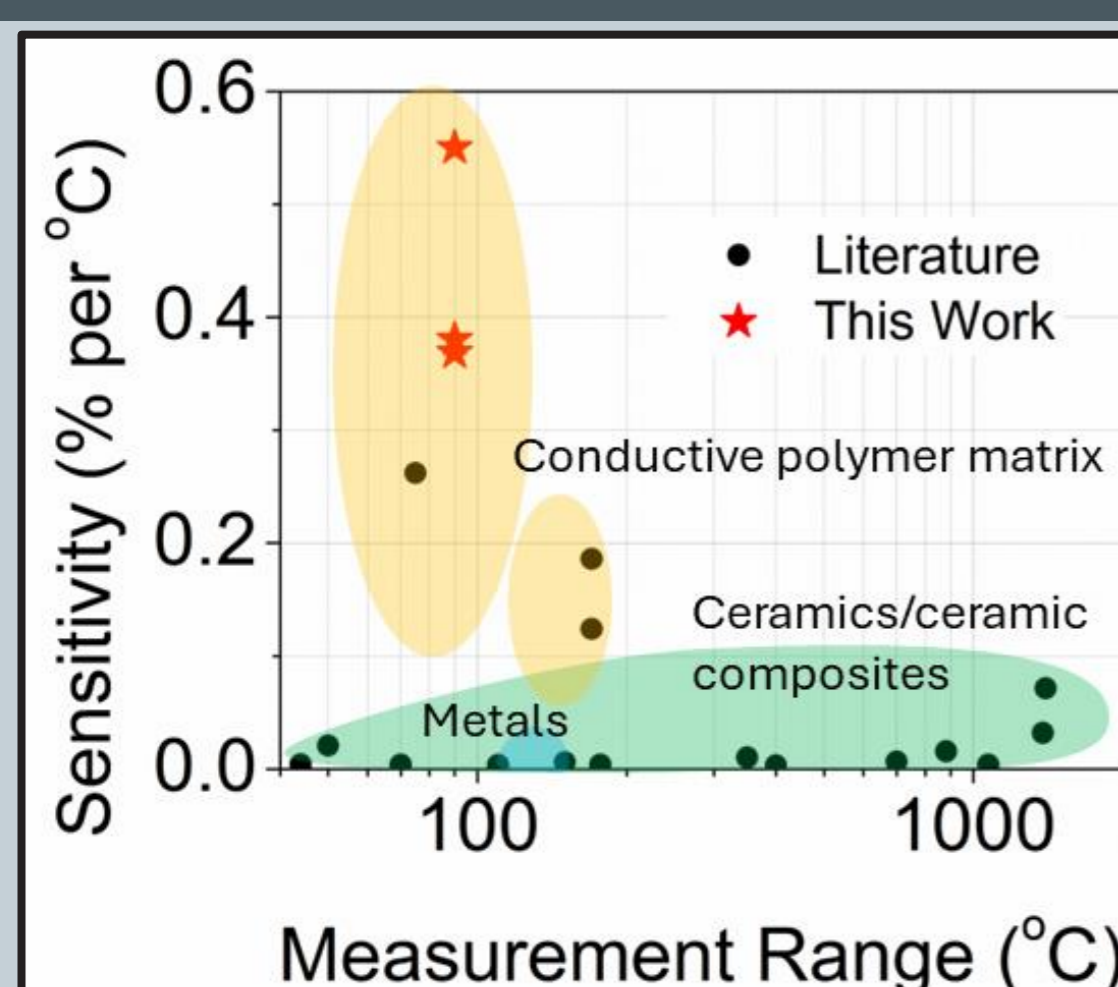
- Environmental mapping
- Chipless E-Nose & E-tongue
- Indoor air quality monitoring



Chipless 2D mapping

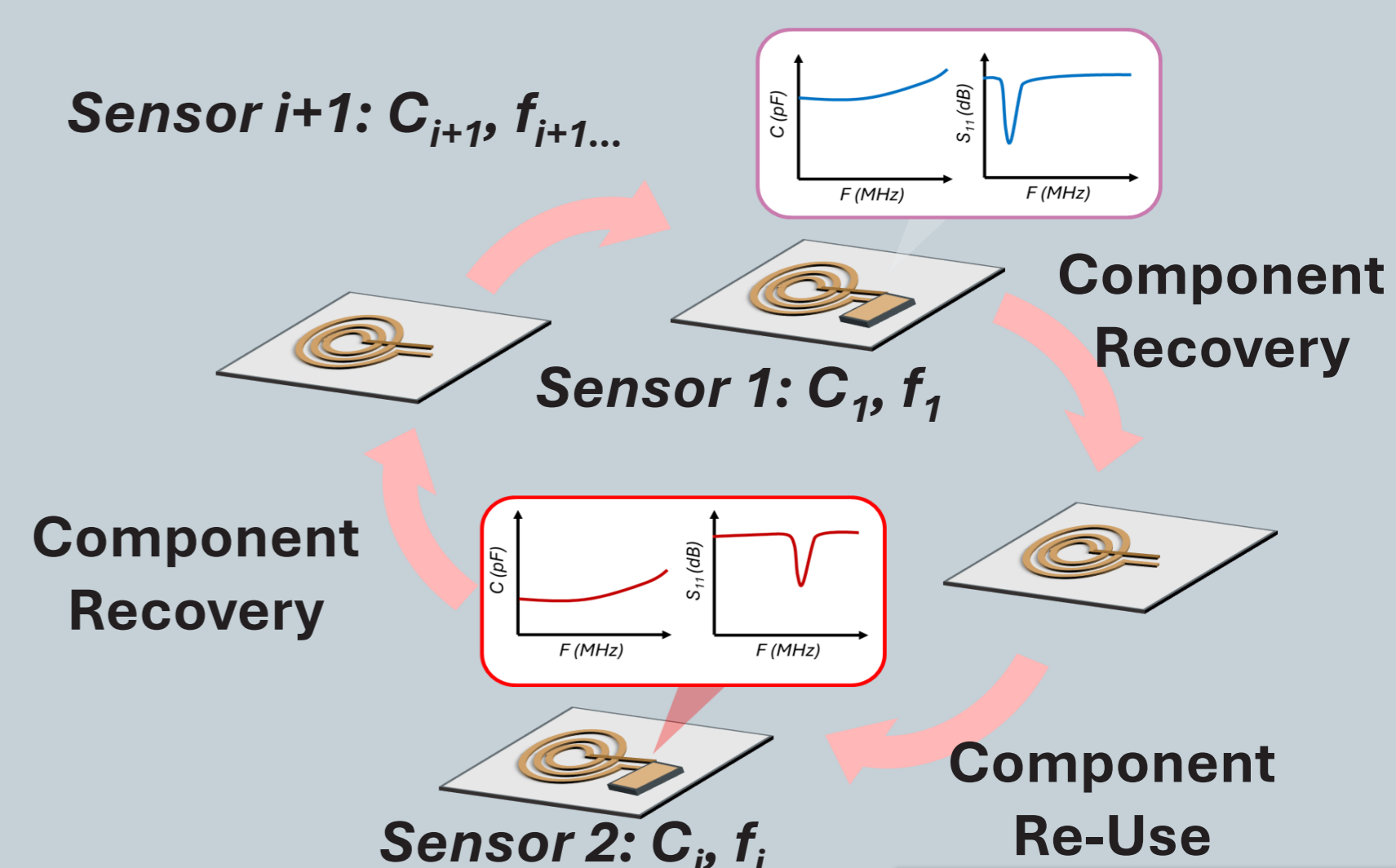


Best-in-class sensitivity



## Circuit Recycling

Recovering and re-deploying sensing materials enables sustainability gains for high-volume applications (packaging, transport tickets, etc.)



## Conclusions & Impact

- First material enabling a multiplexed chipless and wireless sensing readout
- Chipless platform will enable widespread environmental sensing for smart cities

[1] King, B., Bruce, N., Wagih, M., Large-Area Conductor-Loaded PDMS Flexible Composites for Wireless and Chipless Electromagnetic Multiplexed Temperature Sensors, *Advanced Science*, 12 (17), 2412066.  
 [2] King, B., Bruce, N., Wagih, M. Component Recycling in Chipless Devices for Low-Cost, Circular Wireless Temperature Sensors, *Engineering Proceedings*, Submitted.

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[Link to paper](#)

