



Parylene-C Based Nanomechanical Membrane-Flexure Sensor for Biochemical Sensing Applications

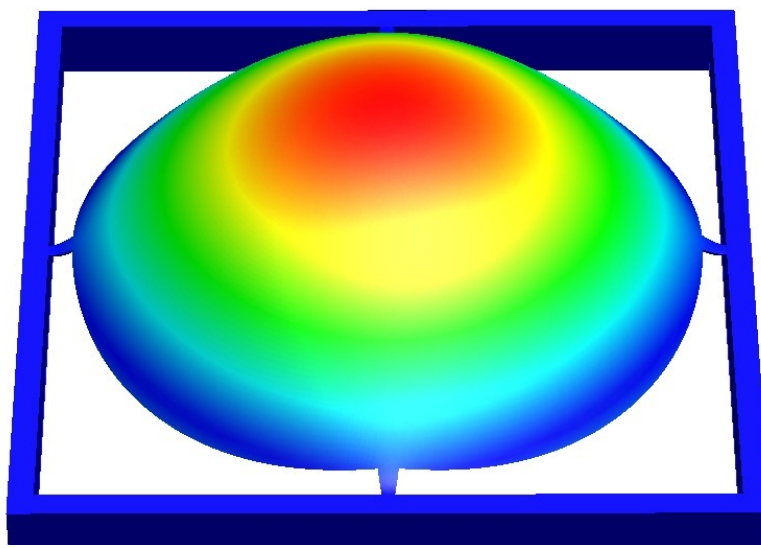
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HIGHLIGHTS

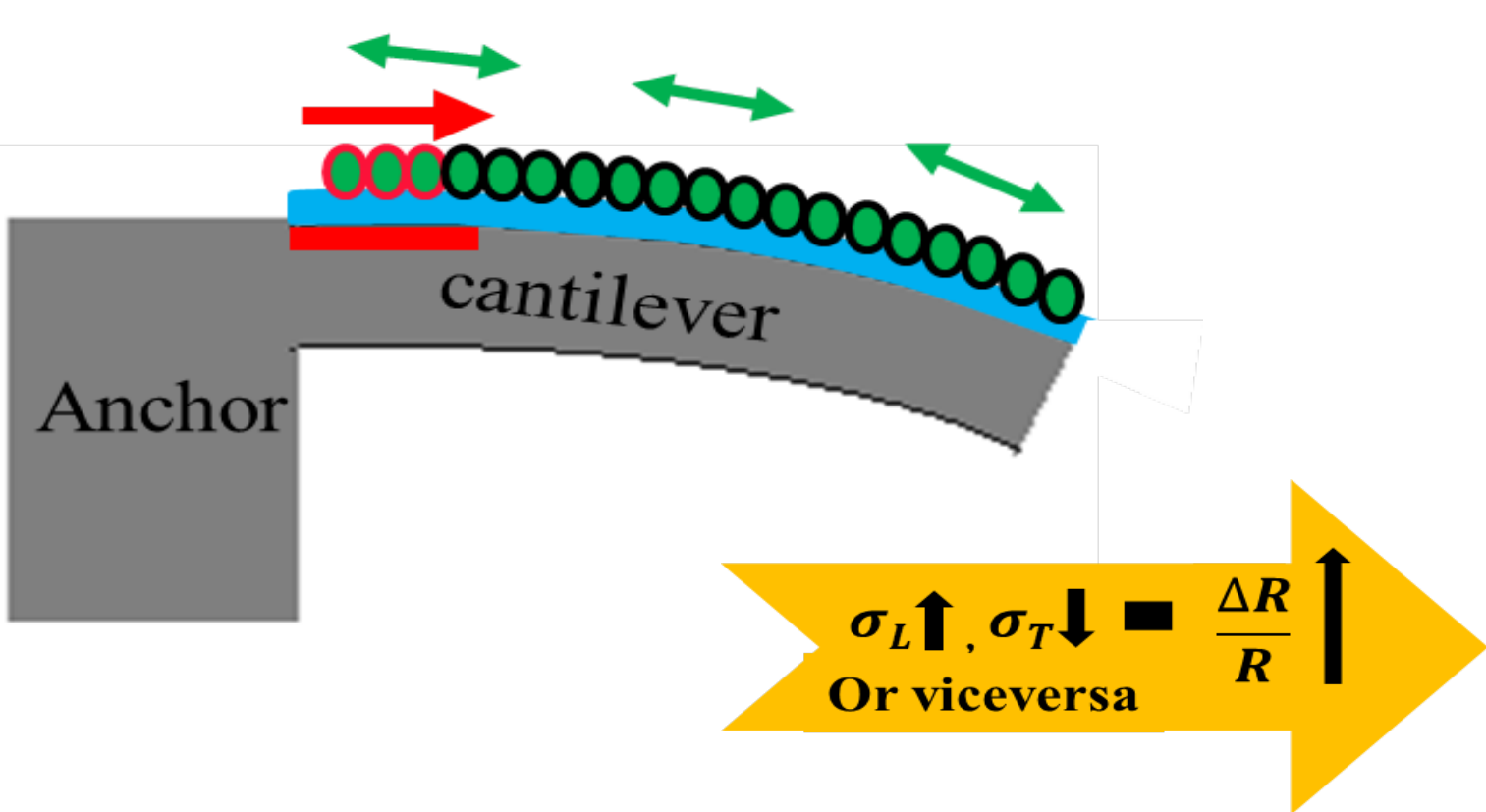
- A novel Nanomechanical Membrane-Flexure (NMF) Parylene-C sensor with piezoresistive transduction has been designed and simulated.
- Chemical vapor deposited (CVD) Parylene-C and high gauge factor (-650) sputter deposited Indium Tin Oxide (ITO) as MEMS structural and piezoresistor layers.
- Surface stress sensitivity of NMF sensor is extracted to be 2.52 ppm/[mN/m] which is 20 times higher compared to cantilever based sensor.
- NMF surface stress sensor for various application areas such as hydrogen gas sensor, detection of volatile organic compounds (VOC) etc.



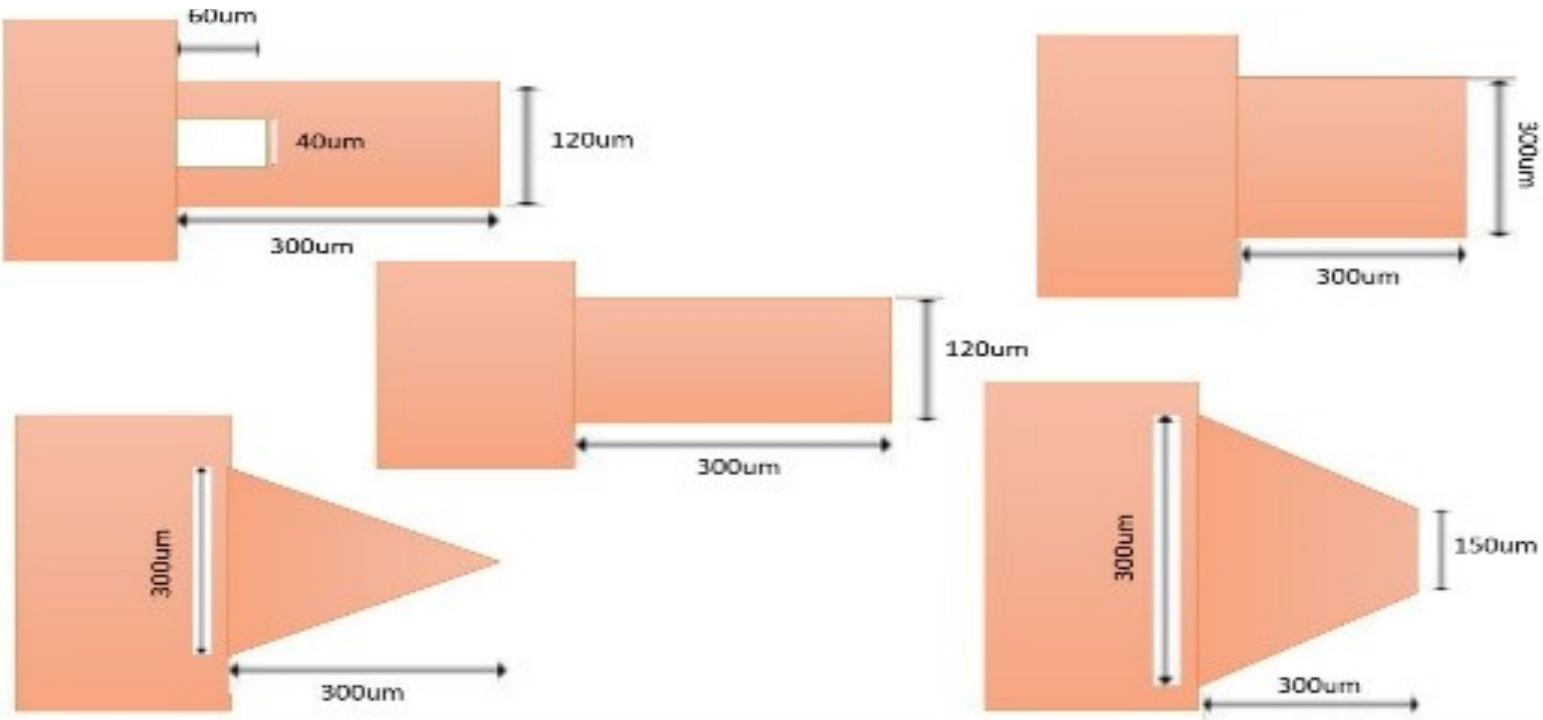
Nanomechanical Sensors : Design and Simulation

The device has been designed and simulated using commercial finite element analysis (FEA) software CoventorWare 10.2.

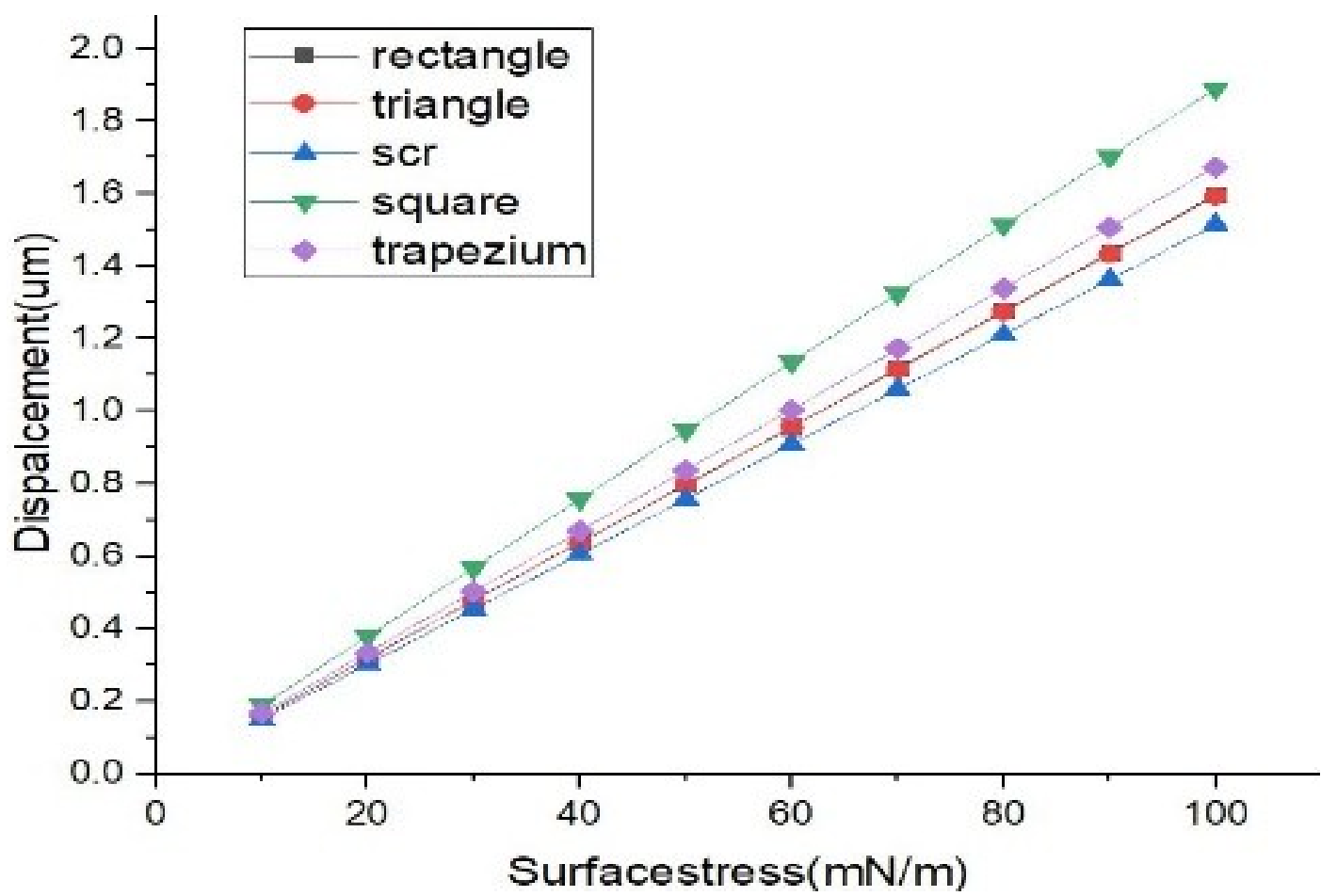
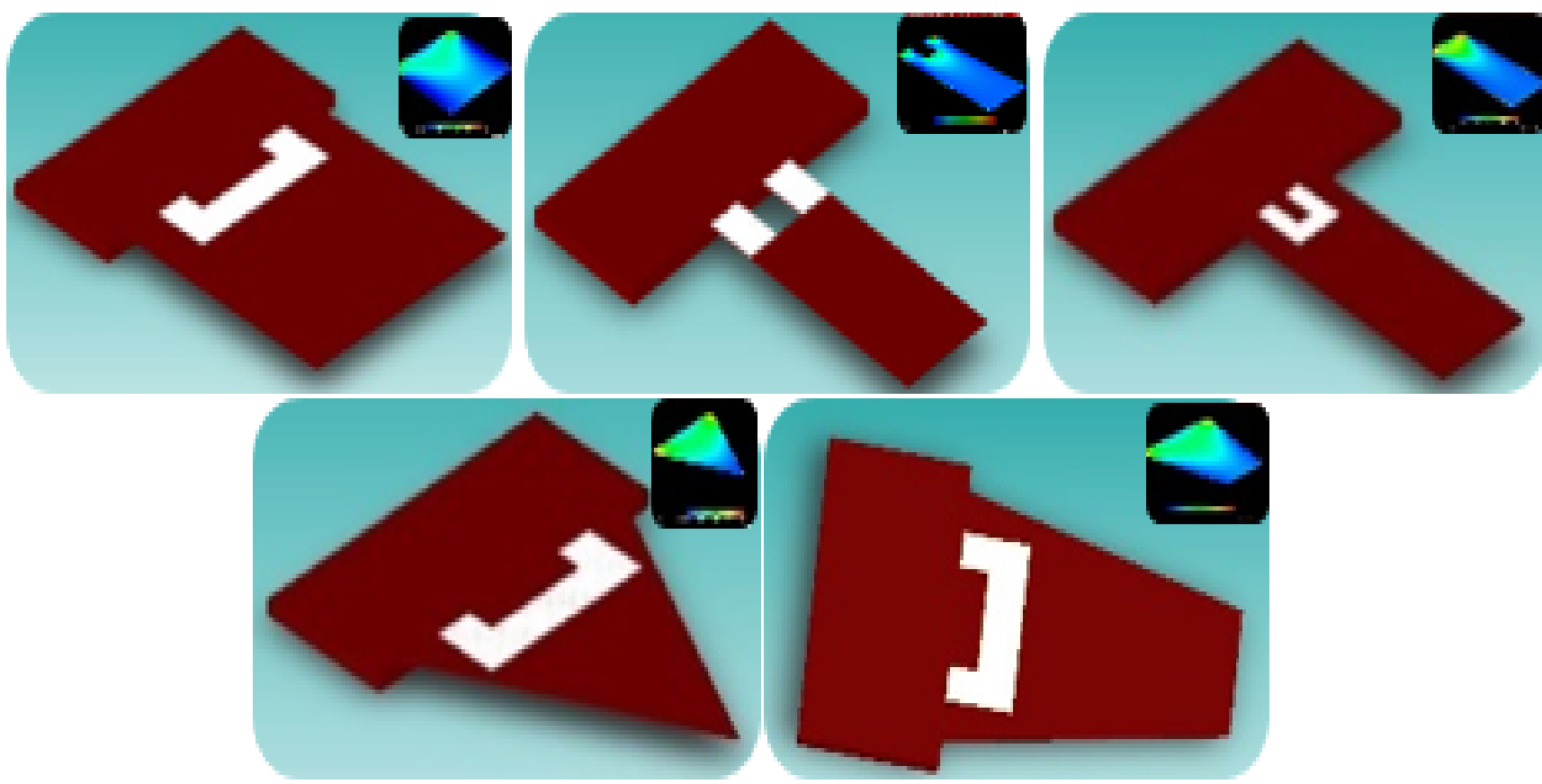
➤Piezoresistive Cantilever principle



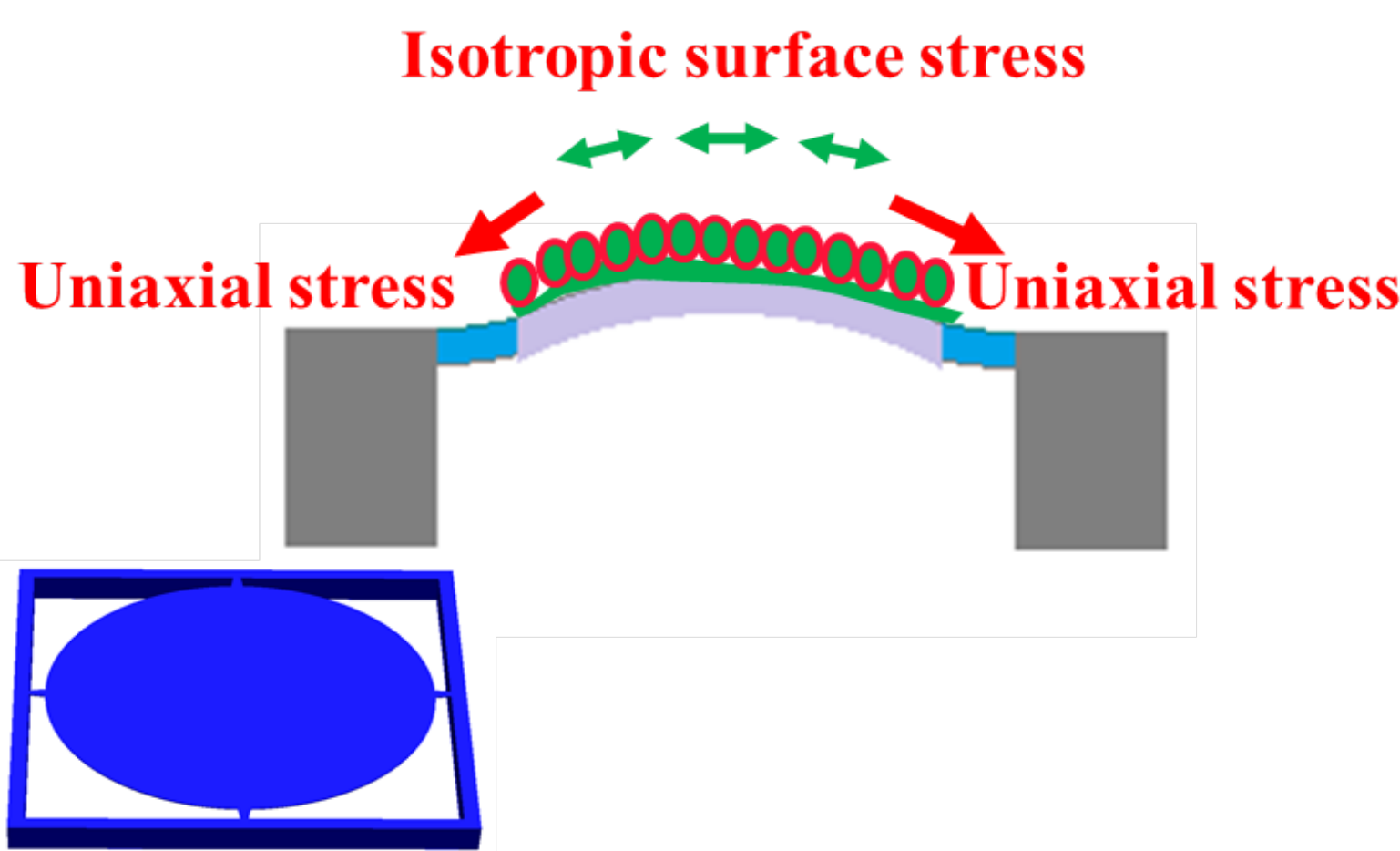
➤Cantilever geometries



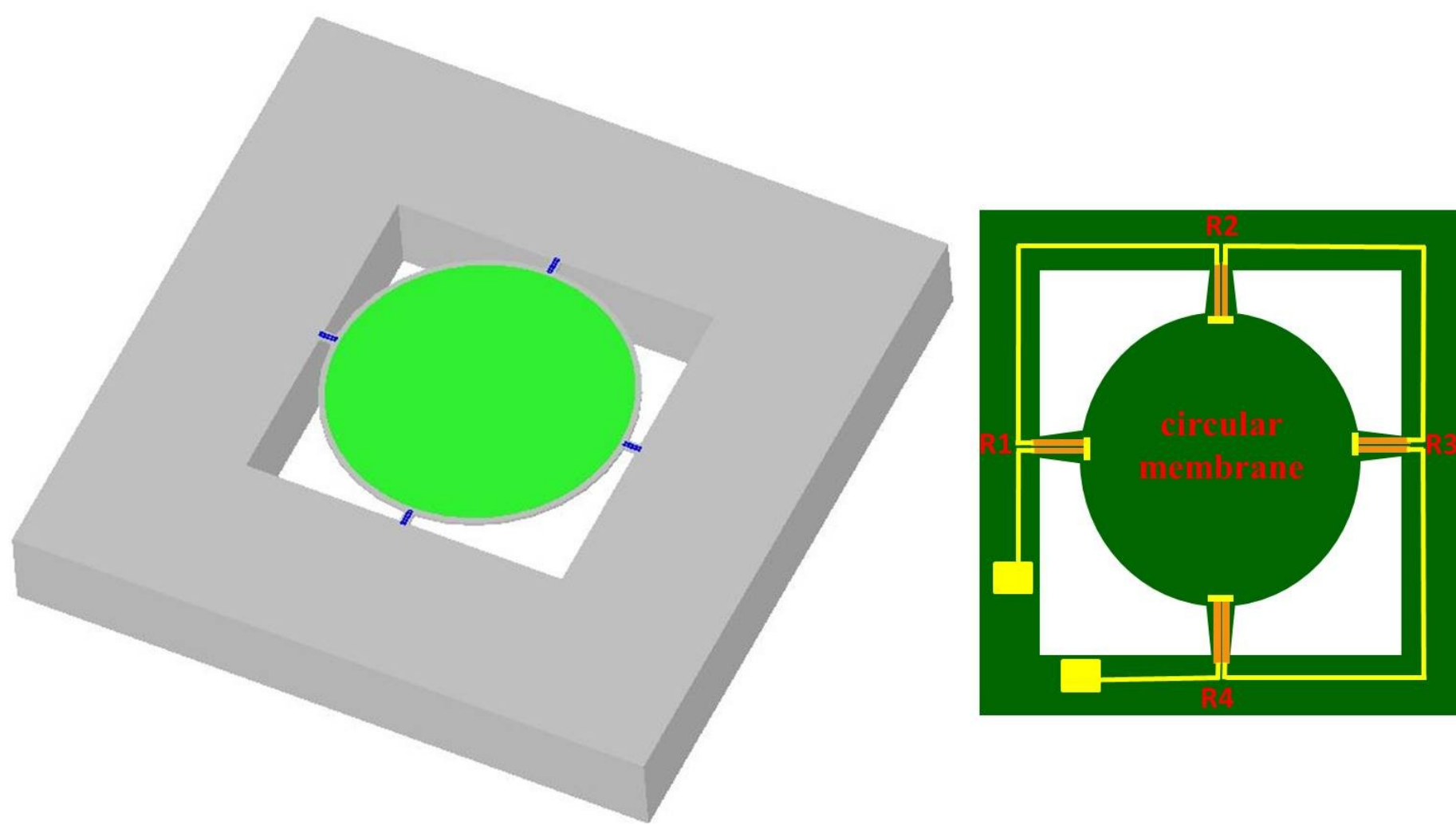
➤FEM Analysis Results



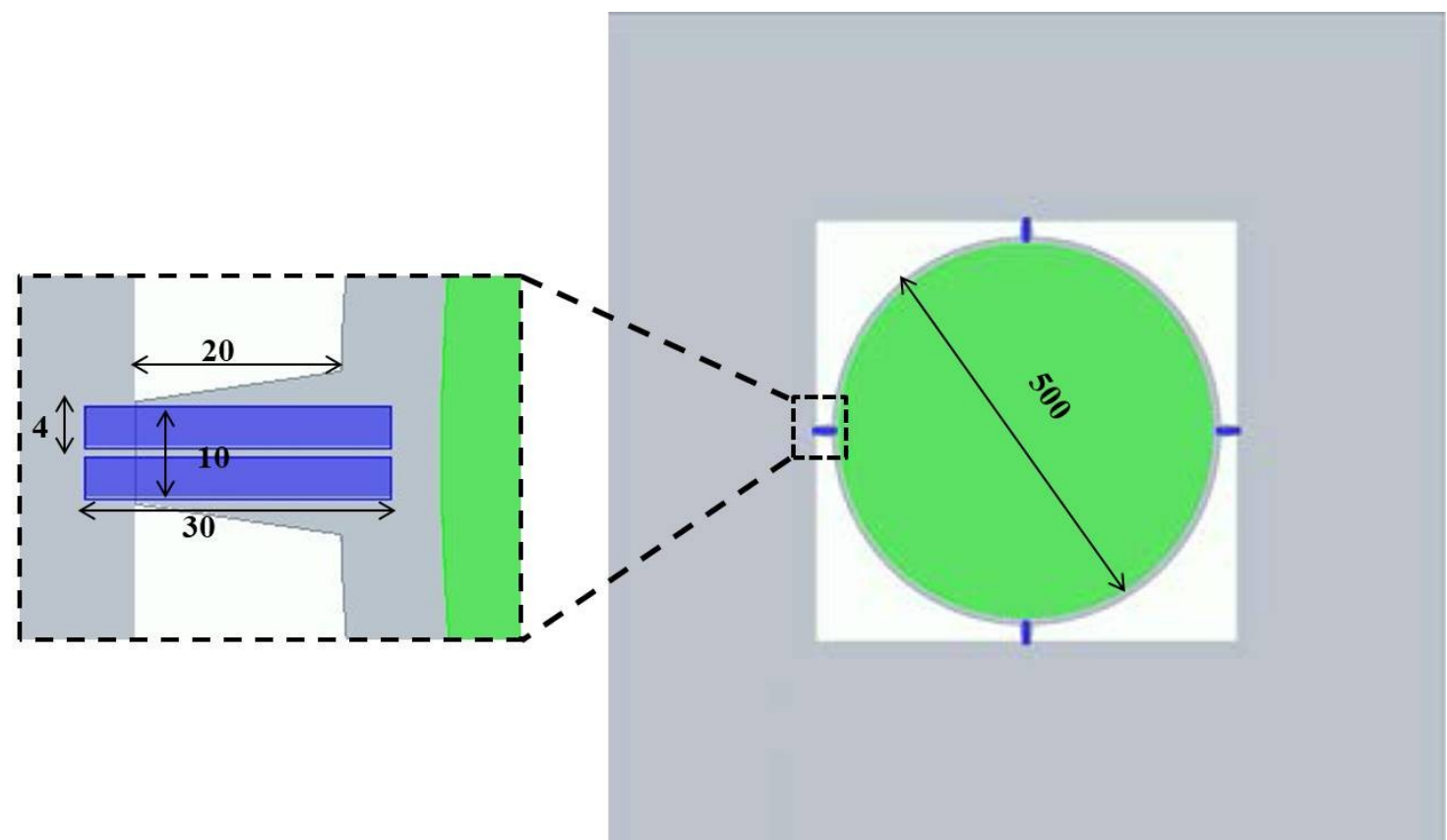
➤Nanomechanical Membrane-Flexure (NMF) principle



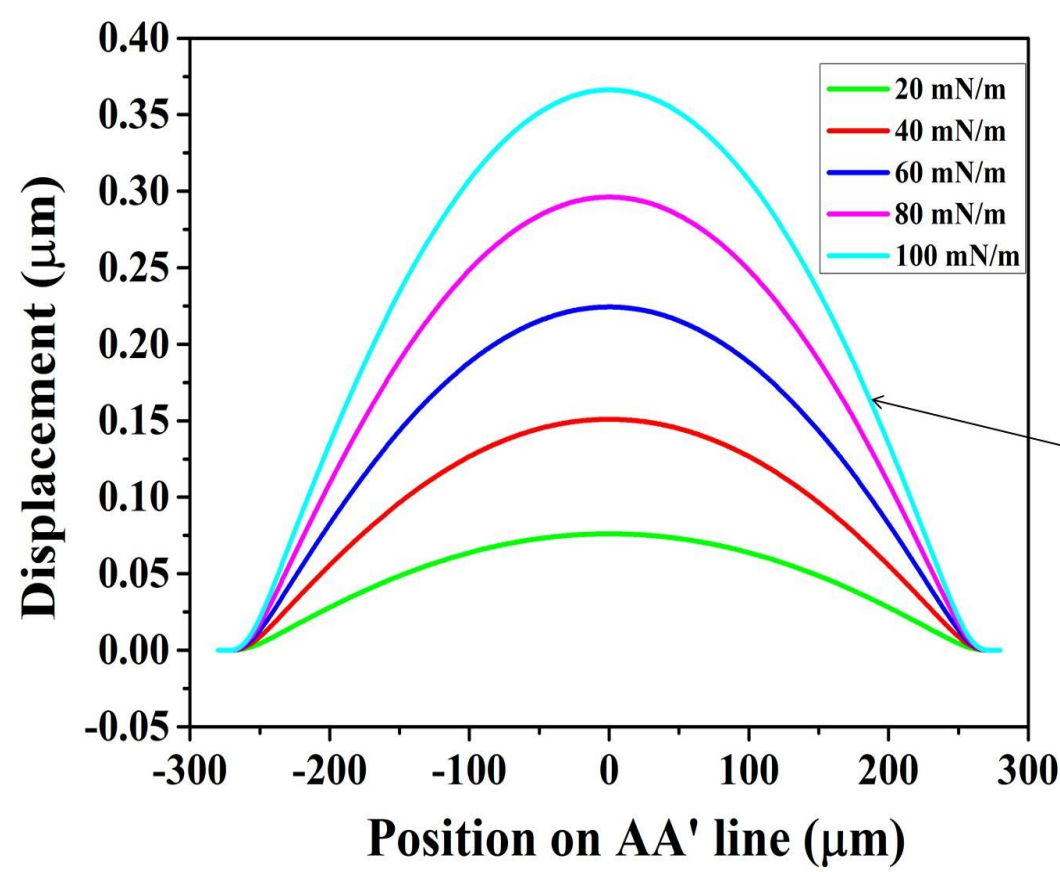
➤NMF schematic



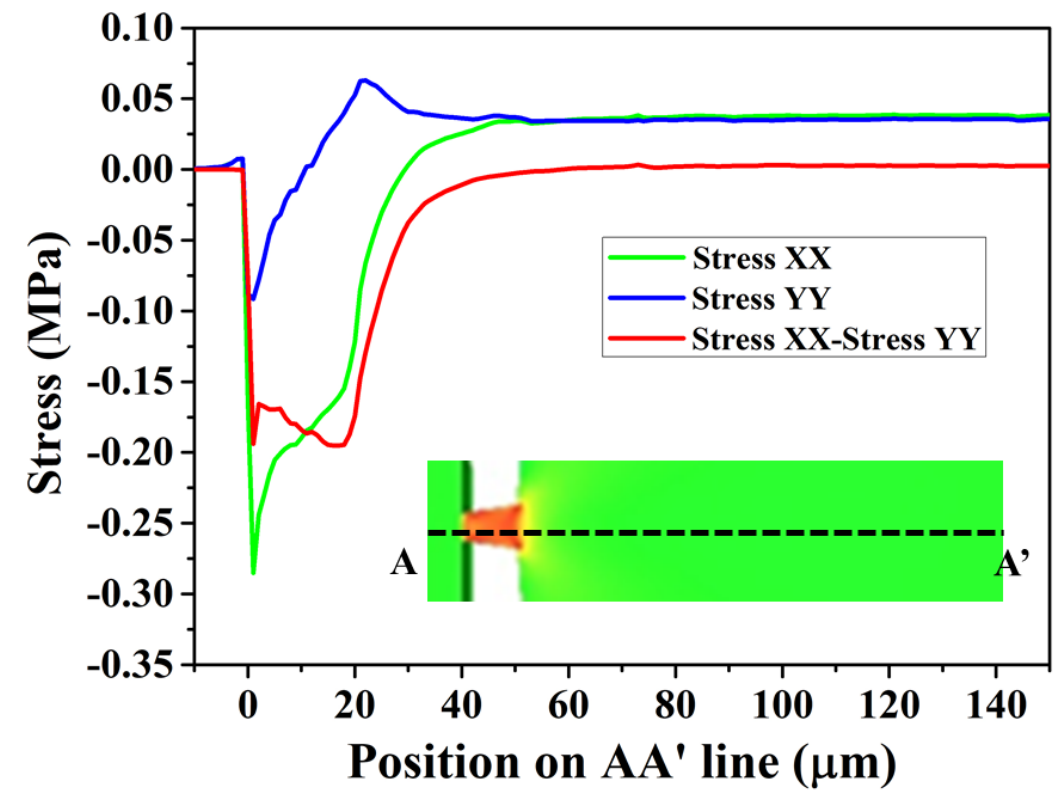
➤NMF Layout



➤FEM results of NMF Sensor

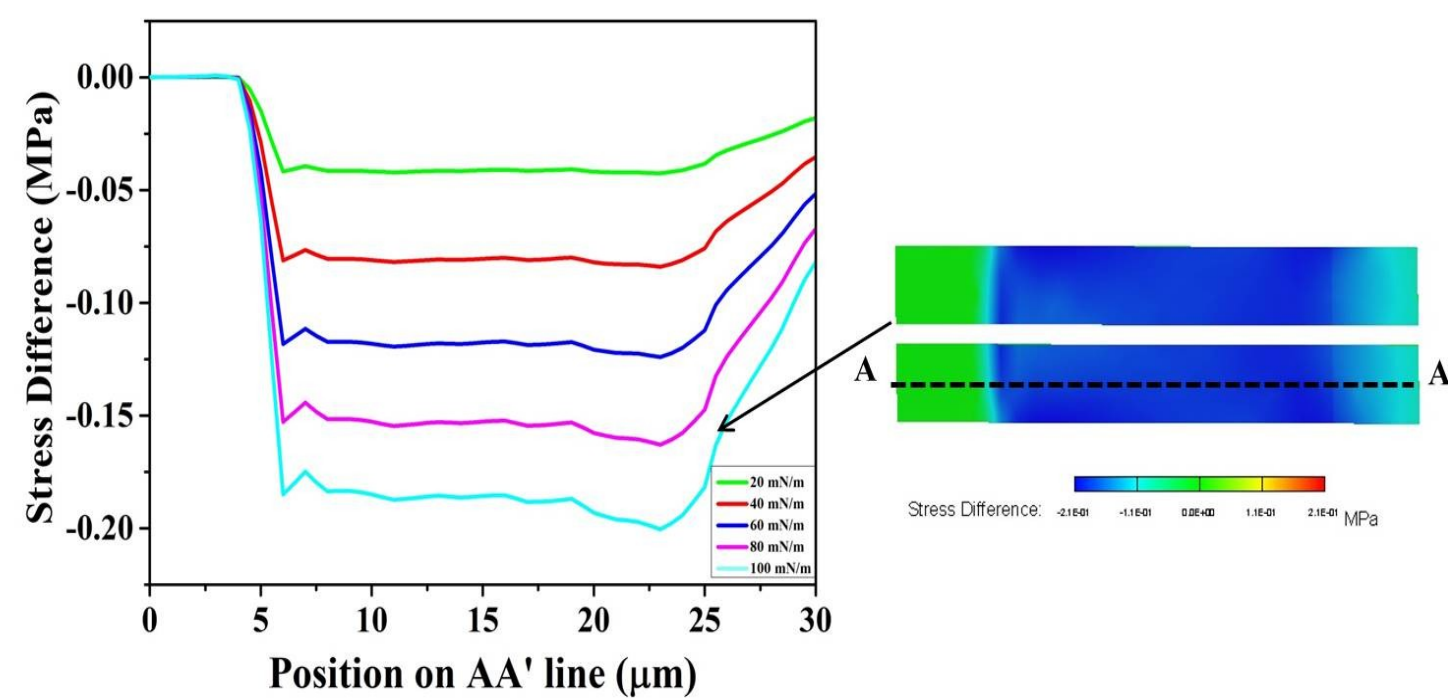


Displacement profile



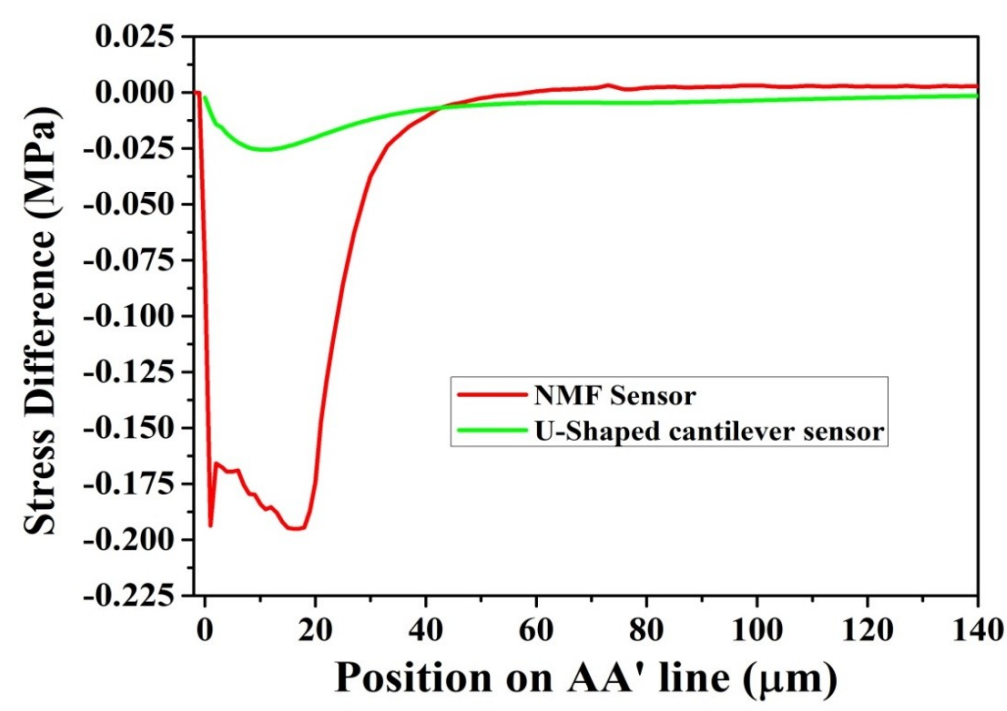
Stress profile

Stress Difference profile

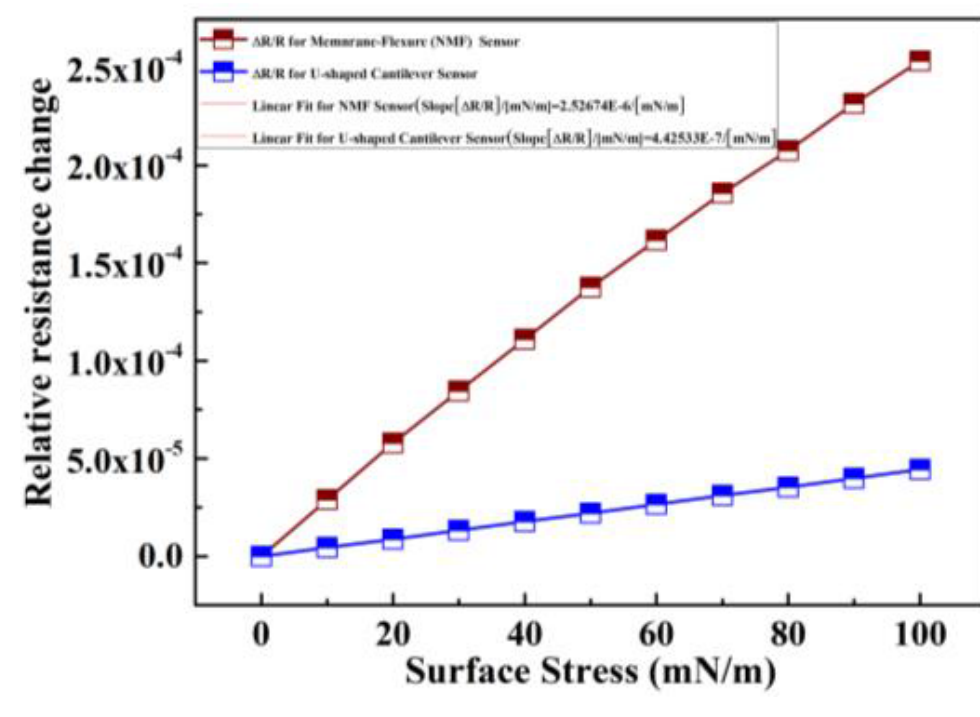


Piezoresistor Stress profile

➤Comparison between NMF and Cantilever



Stress profile



Surface stress sensitivity plot

Type	Sensitivity (ΔR/R/[mN/m])
Membrane-Flexure Sensor	2.53×10 ⁻⁶
Rectangular Cantilever	1.61×10 ⁻⁷
Triangular Cantilever	1.53×10 ⁻⁷
Trapezoidal Cantilever	1.09×10 ⁻⁷
Square Cantilever	1.04×10 ⁻⁷
U-Shaped Cantilever	4.43×10 ⁻⁷

Sensitivity comparison

➤Conclusion

- Parylene-C based NMF sensor with low temperature deposited ITO as piezoresistor has been designed and simulated.
- The surface stress sensitivity of NMF sensor (2.52 ppm/[mN/m]) is found to be 20 times higher than conventional cantilever sensor.
- Simple and cost effective polymer MEMS integration to make highly sensitive nanomechanical sensor.

ACKNOWLEDGEMENTS

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