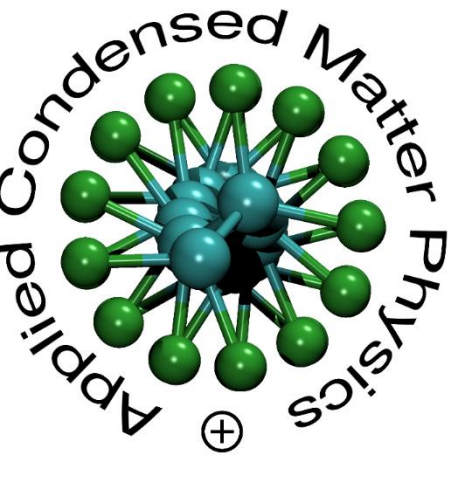


Deformable silicone-elastomer sensors for structural health monitoring: assessment of strain sensitivity and correction for thermal expansion

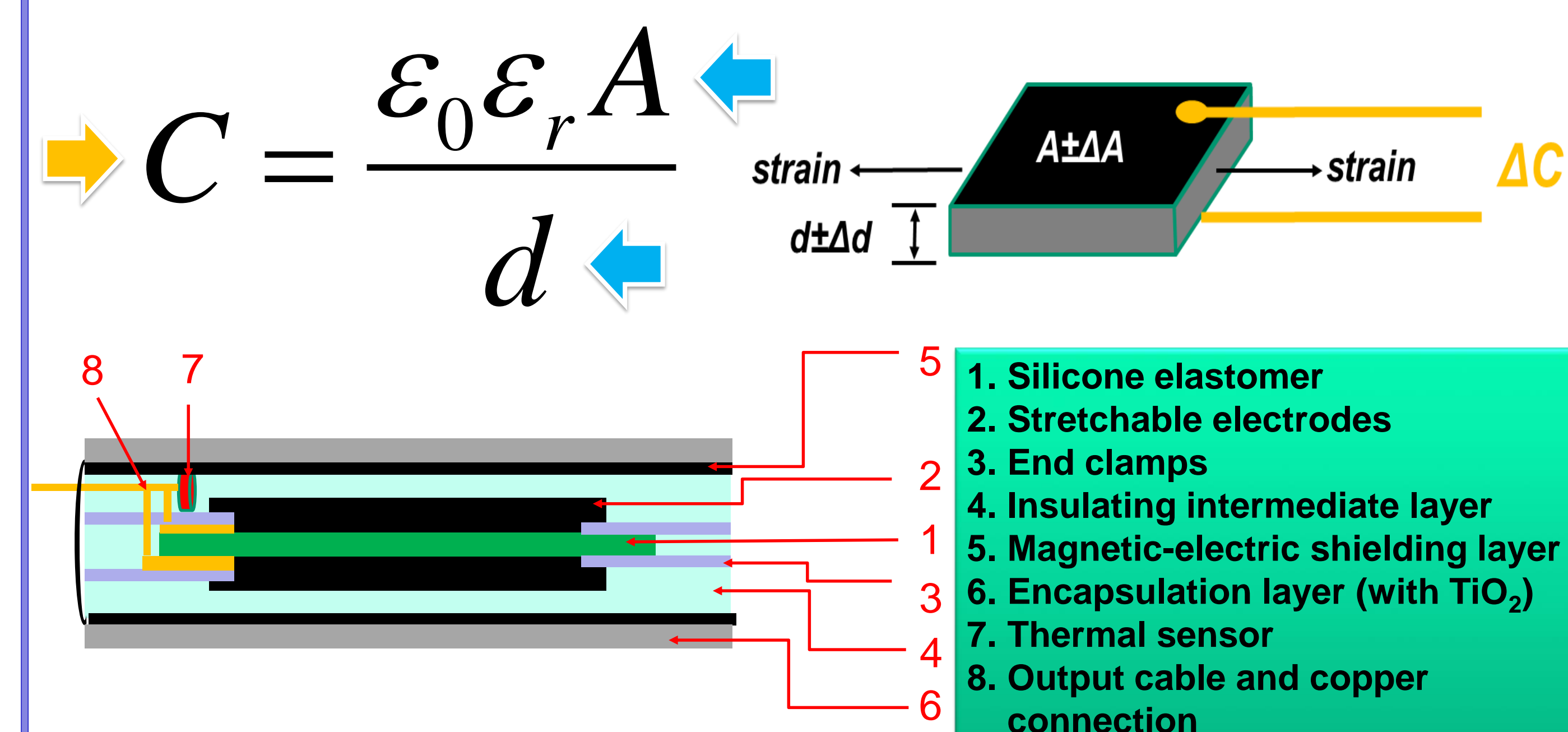
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Abstract

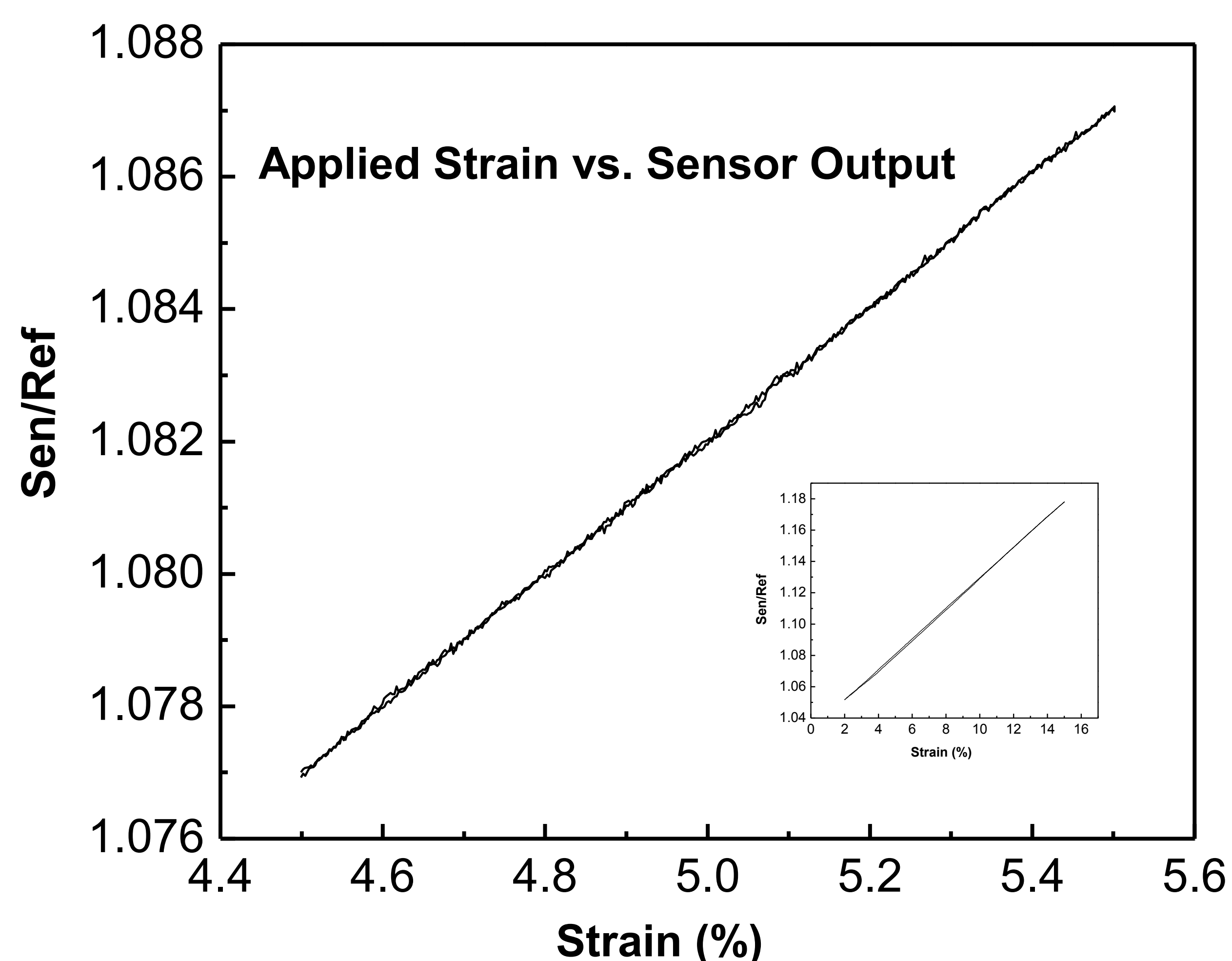
Within the framework of SENSKIN EU project (grant No. 635844), we have developed a soft capacitive sensor using silicone dielectric elastomer for Structural health monitoring (SHM). This sensor has a thin layer of stretchable silicone dielectric film and soft silicone electrodes as the active layer, which transduces strain signal into the easy-monitored capacitance change. The sensor output is measured as a ratio of the sensor's capacitance to the known value of the reference capacitor. The capacitive output of the sensor showed a linear response upon stretching in the strain range of 4.5 % to 5.5 % with a pre-strain of 5.0 %. The sensor output increased by 0.01 when the strain was increased by 1.0 %. The sensor was exposed to a temperature change from -35 °C to 55 °C (the supposed working temperature range) with a ramping of 0.2 °C/min and, as a result, it showed a linear temperature-dependence behavior with a slope of -0.001 sensor output per °C. Therefore, with the help of the embedded Platinum-1000 temperature sensor, the thermal expansion effect on the capacitive output can be excluded from the actual strain-induced capacitance change. These results provide practical reference to the application of the silicon-elastomer sensor for the SHM systems.

Deformable Capacitor

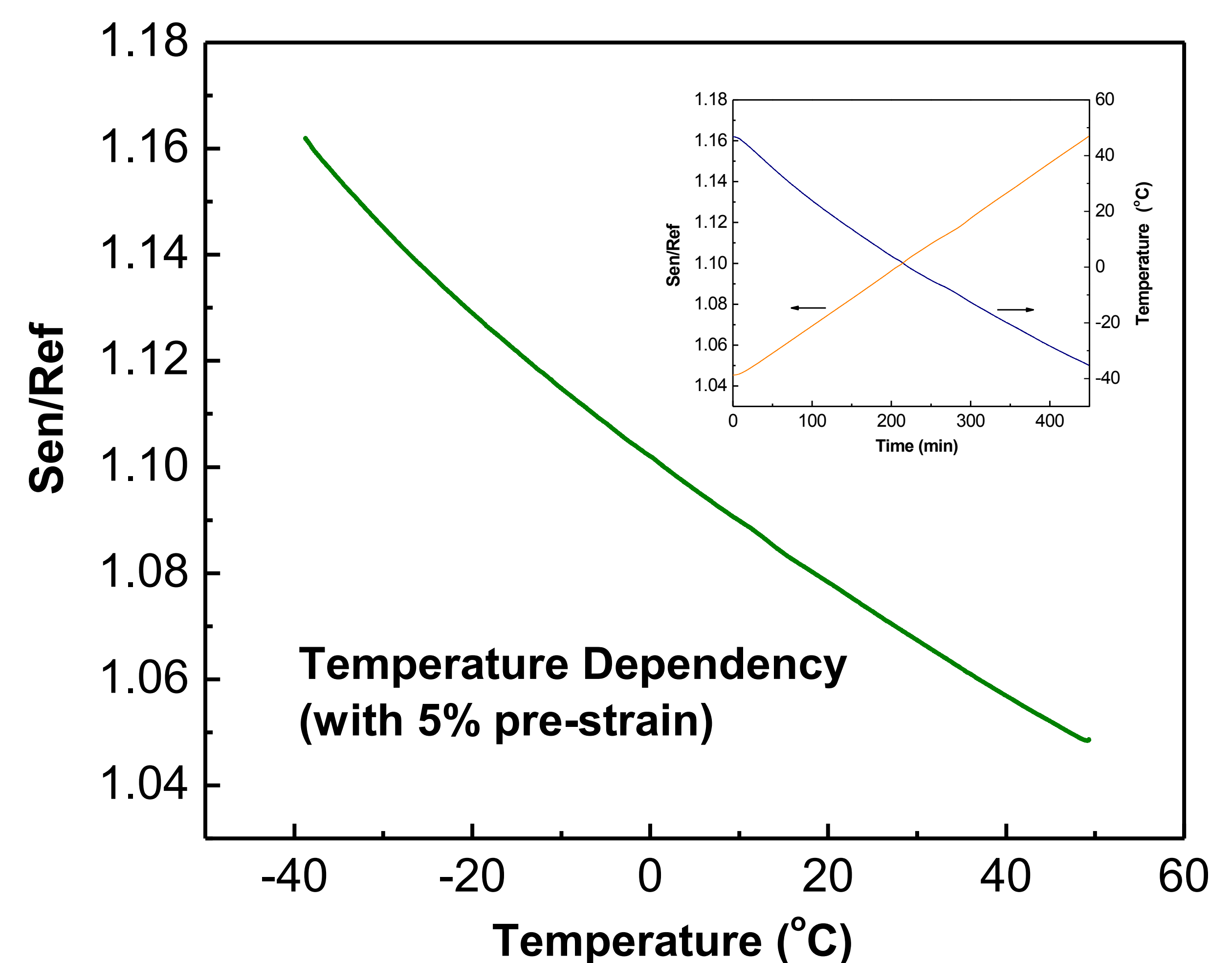


Sensor without electromagnetic shielding layer and encapsulation. Compliant electrodes, copper end-clamps, embedded temperature sensors can be seen.

Sensor (in final appearance) fixed on strain test equipment.



- ✓ Linear response within the applied strain range (Up to 15% strain)
- ✓ The sensor output increased by 0.01 when the strain was increased by 1.0 %.



- ✓ Sensor output changes with temperature synchronously (almost linear)
- ✓ Changing rate: -0.001 sensor output per °C

Conclusion and Outlook

1. Soft, skin-like strain sensor were fabricated with silicone elastomers.
2. Sensor output value changes linearly with applied strain.
3. Thermal expansion effect on capacitive change could be compensated for using a built-in temperature sensor

Acknowledgments

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