LIG for Use as a Resistive Sensor

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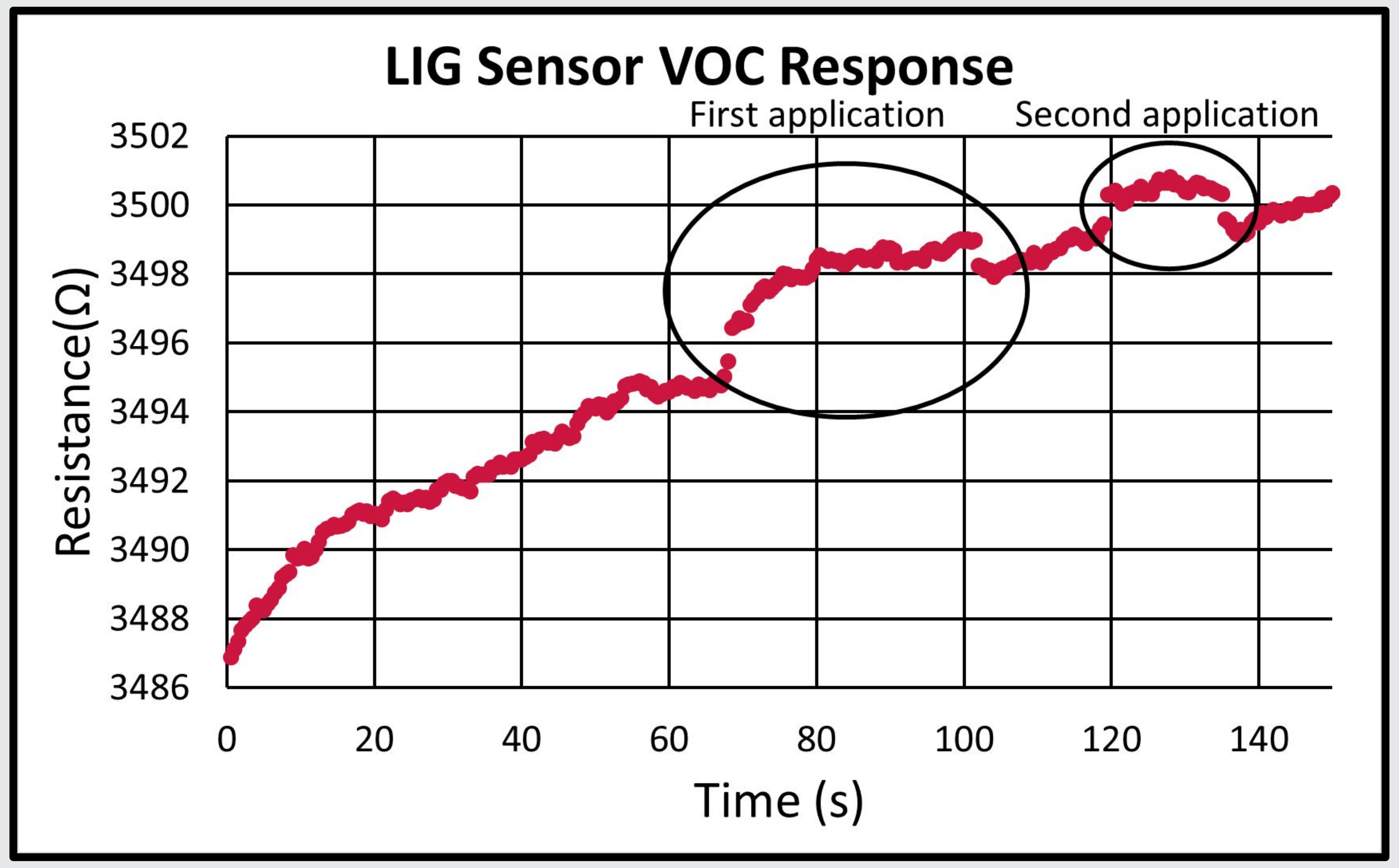
LIG is laser-induced graphene.

Using a 10,600 nm Glowforge CO2 laser, the non-adhesive backing surface of high-temperature polyimide Desco or Kapton tape is irradiated with infrared radiation. This causes the carbon atoms in the polyimide plastic to rearrange themselves into the flat sheet structure characteristic of graphene. The surrounding non-irradiated plastic does an adequate job of keeping the graphene sheets from sliding away. There is some swelling of the polysiloxide adhesive.

LIG is being researched as a VOC sensor.

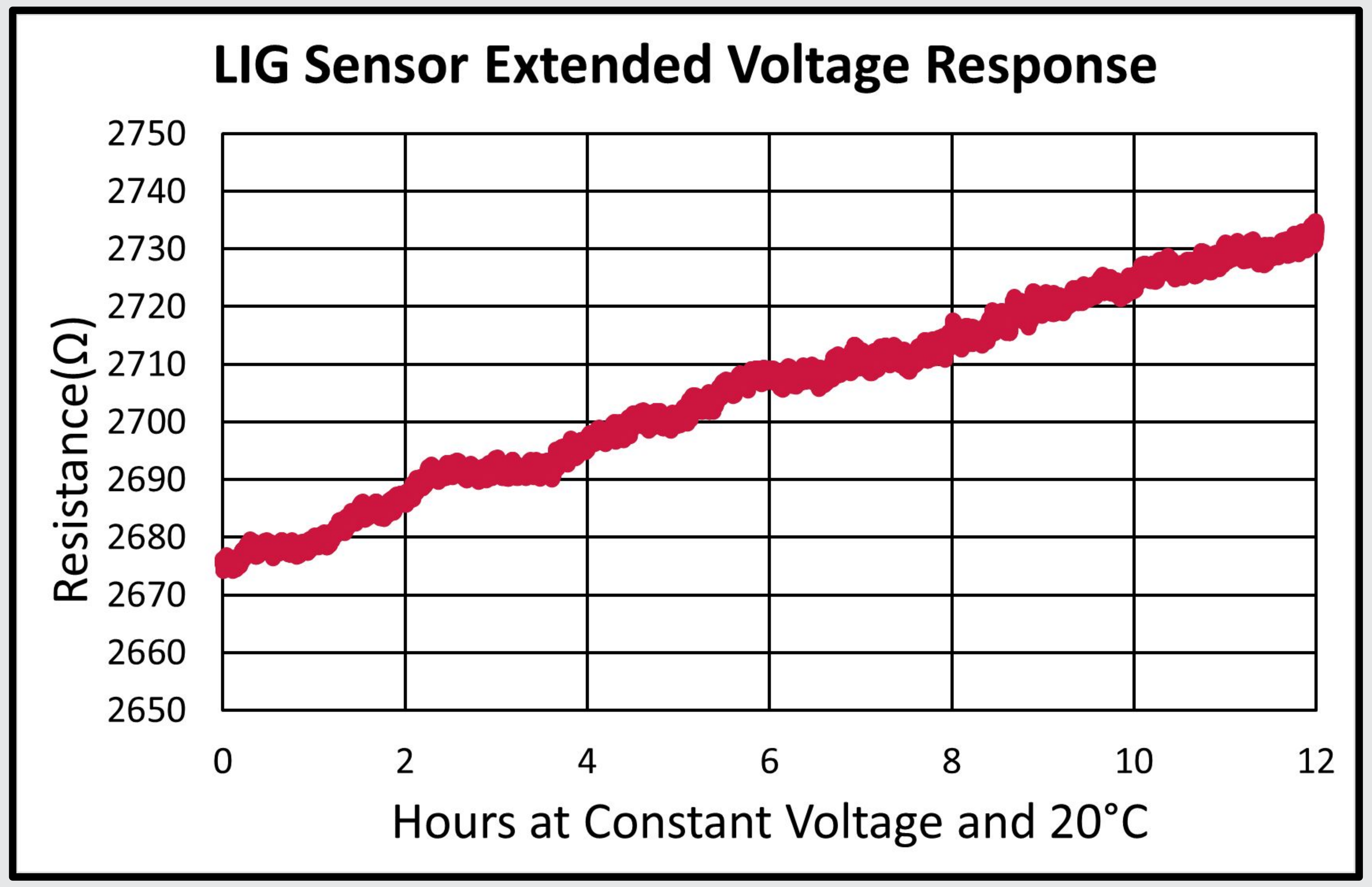
Previous literature has characterized LIG sensors as responding to the presence of volatile organic compounds (VOCs). Various VOCs can be discriminated between by the magnitude and duration of the resistance change caused by the VOC binding to the graphene structure. Characterizing this response is desirable in order to study interactions between native and transplanted species, which may have different VOC emission signatures to one another. Attempts to replicate these findings yielded tepid results, with the sensor's response to concentrations of VOCs being muted compared to background noise as shown in the figure below.



During a typical recording session, a syringe of concentrated VOCs is depressed above the sensor's surface. There will be a small increase in resistance for several seconds, before it decreases again. This concentration was procured using Wyoming Big Sagebrush leaves.

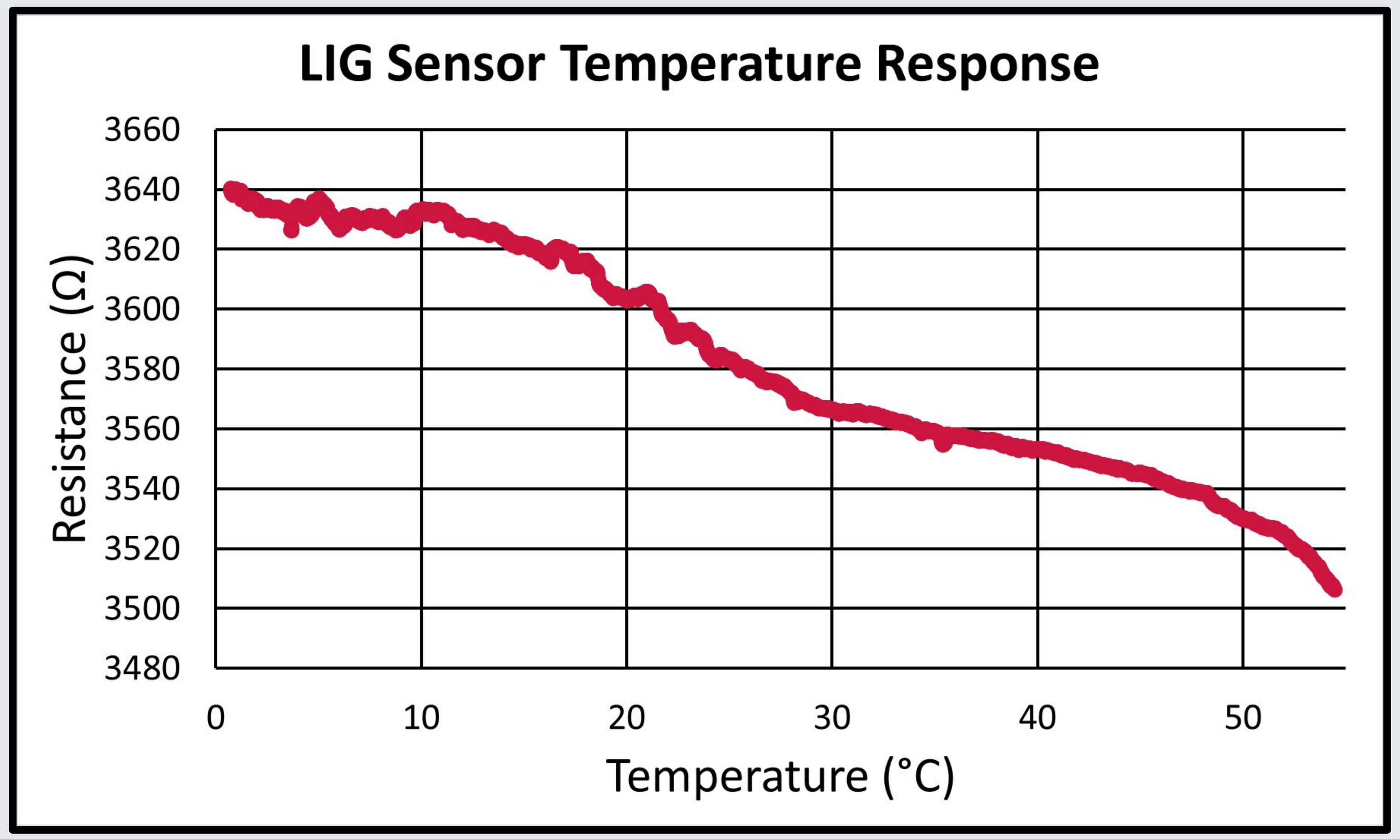
LIG degrades due to electrical currents.

LIG degrades quickly when current is run through it. Even the small amount necessary to measure its resistance causes its baseline resistance to rise by up to 7% in 24 hours. This may be mitigated using intermittent measurements.



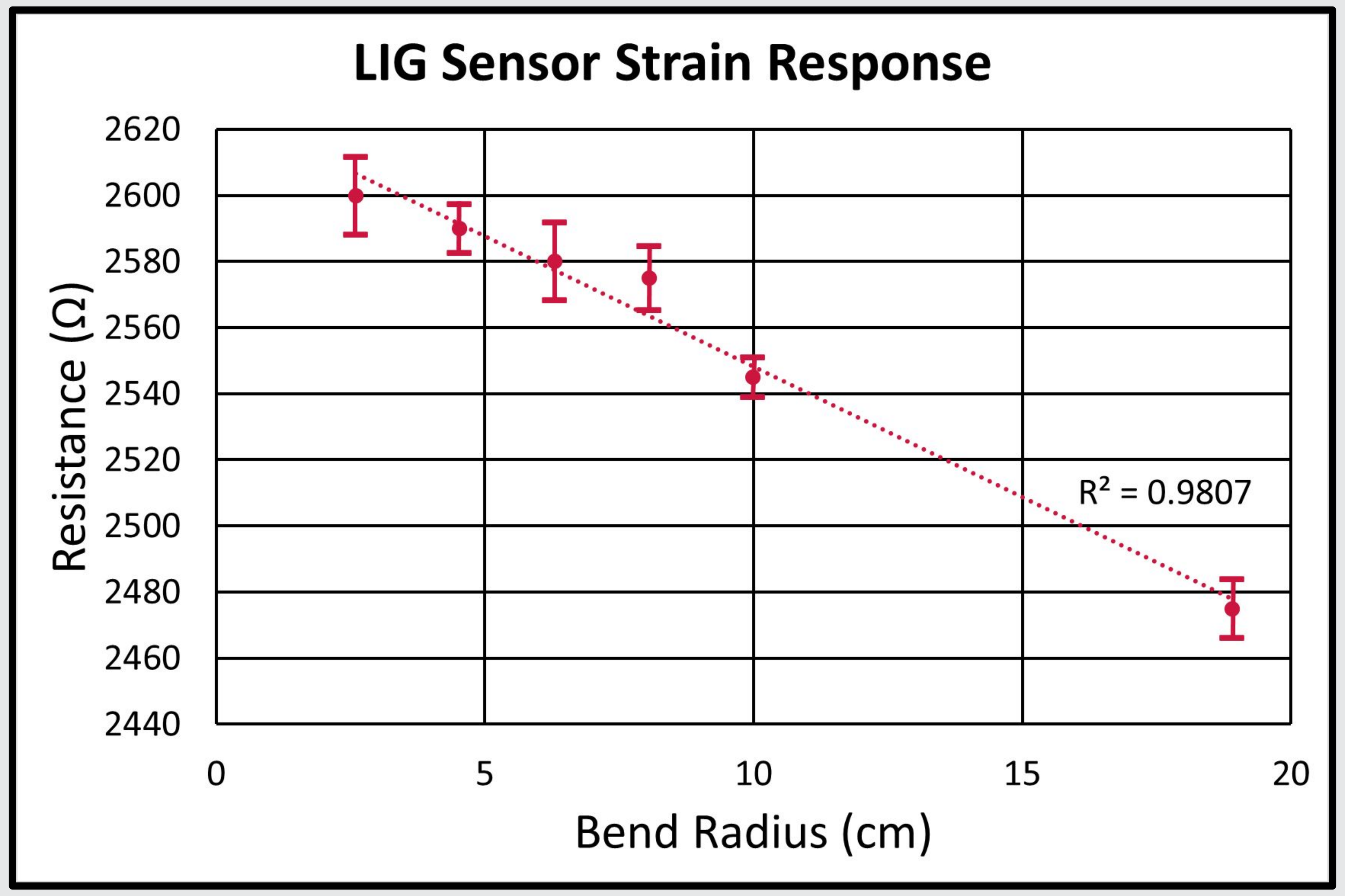
LIG's resistance changes with temperature.

The temperature coefficient of the LIG is small but non-negligible. As expected of a a semiconductor, its resistance decreases monotonically with temperature for a given electron transport mechanism. Whether this needs to be compensated for in practice depends on the application.



LIG's resistance changes as it bends.

As the LIG substrate backing is bent, the resistance of the trace varies, increasing with decreasing bend radii. Previous literature had considered this to be a source of noise when trying to measure the LIG's chemiresistivity, but it could also be developed into a fully-fledged flex sensor due to this response.



The resistance of the trace appears to decrease linearly with increasing bend radius, compared to a baseline of 2450±9.60 Ω. Error bars indicate one standard deviation.

Future prospects in LIG research:

Further research is required to improve the fabrication consistency between sensors. Furthermore, discriminating between low concentrations of species of VOCs that induce a large response and high concentrations of species of VOCs that induce a small response is not obviously possible. In this case characterization may be highly dependent on the duration of the response, requiring even further sensitivity to yield usable data.

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