Sensors made of 2D materials – gas, respiration, and heartbeat

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Chemical sensors are an enabling tool across many industries, including the largest ones such as energy, transport, and construction. Low-cost, high performance sensors, especially ones compatible with flexible substrates, are becoming increasingly important with the development of mobile gadgets and wearable devices. Here we show chemical sensors produced in a facile way from inexpensive materials. The sensors, made of liquid-phase exfoliated (LPE) 2D materials deposited on a substrate with Langmuir-Blodgett assembly, are made with an inexpensive process that can be applied to any substrate, including flexible ones. The sensors that we make from graphene are more sensitive to humidity than ones demonstrated with CVD graphene [1], with up to 30% change in sheet resistance upon exposure to water vapor. The LPE graphene sensors are also ultrafast, enabling applications such as real-time respiration monitoring and touchless finger proximity detection [2]. We also demonstrate chemiresistive sensing of nitric acid vapour, ozone gas, and CO2 [3] with the same films. Using thin sheets of LPE PtSe2 we show NH3 and NO2 gas detection with unprecedented 200 ppb and 15 ppb detection limits, respectively.

We also present our latest results on sensors of physiological parameters made of laser-induced graphene (LIG). Such graphene is readily and quickly obtainable, and can be made into various sizes and shapes. We use LIG on different polymer substrates to produce flexible wearable sensors of heartbeat and respiration.

References

[1] Smith, A. D. et al, Nanoscale 45, 19099 (2015).
[2] Andrić, S. et al, Nanotechnology 32, 025505 (2020).
[3] Andrić, S. Et al, Chemosensors 9, 342 (2021).

Figures

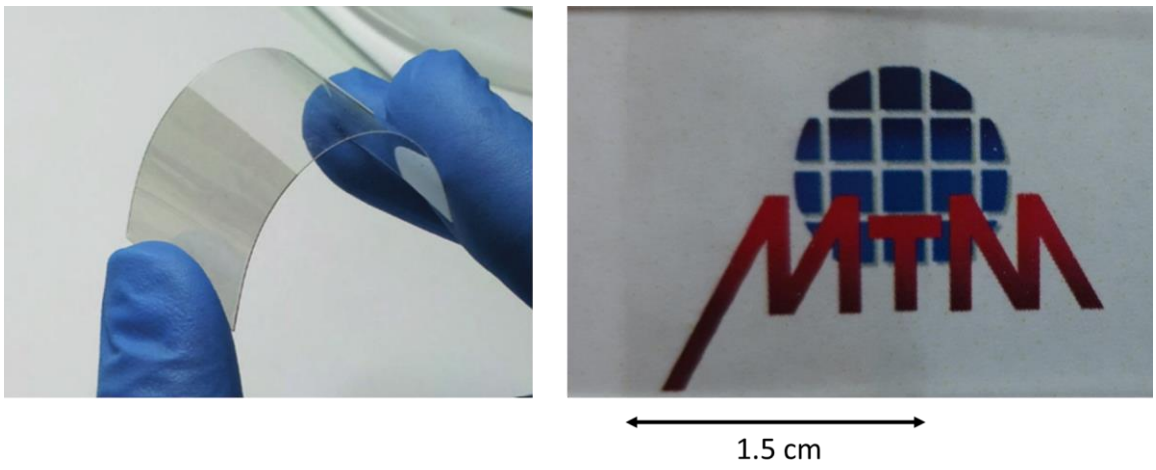

Figure 1: Large area, thin graphene film on flexible substrate for transparent conductors and sensing.