Laser-induced graphene strain sensors produced by ultraviolet irradiation of polyimide

Alexandre. F. Carvalho[1], António. J. S. Fernandes[1], Cátia Leitão[1], Jonas Deuermeier[2], Ana. C. Marques[2], Rodrigo Martins[2], E. Fortunato[2], Florinda. M. Costa[1]

1 — Department of Physics & I3N, University of Aveiro
2 — I3N, University NOVA of Lisbon

In the new era of the "internet of things" there is a need for data to be processed. The smartification of our daily objects implies not only the ability of data processing but most importantly of data collecting. Nowadays a myriad of advanced MEMS (Micro-Electro-Mechanical Systems) sensors are already deployed in hi-tech appliances such as phones, computers and other electronic devices. However, in lower-end devices, such as wearables or smart furniture, applying such sophisticated sensors is an overkill approach. Thus, there is a requirement for low-cost, low-tech, and inexpensive sensing solutions. With the development of cheaper new synthesis and processing techniques, graphene and graphene-containing sensors are proving to be competitive in many fields as in photodetection, biosensing and electromechanical transduction. Laser-induced graphene (LIG) is one of those candidates and can be obtained by irradiation of a polymer, such as Kapton, by a laser source.

The I3N | Carbon-based Materials and Laser Processing group demonstrated that it is possible to obtain LIG foams using an ultraviolet laser instead of the typical infrared CO_2 laser source (Fig.1). Using this approach, a four-fold decrease in the penetration depth (5 µm) is achieved, while the spatial resolution is doubled, when comparing to the state-of-the-art. Electromechanical strain LIG sensors were patterned in polyimide substrates with different thicknesses and their performance to strain, bending and force inputs was measured. A low-cost arterial pulse wave monitor was built, exploring the high force sensitivity of the sensors produced on the thinner substrates (Fig.2).

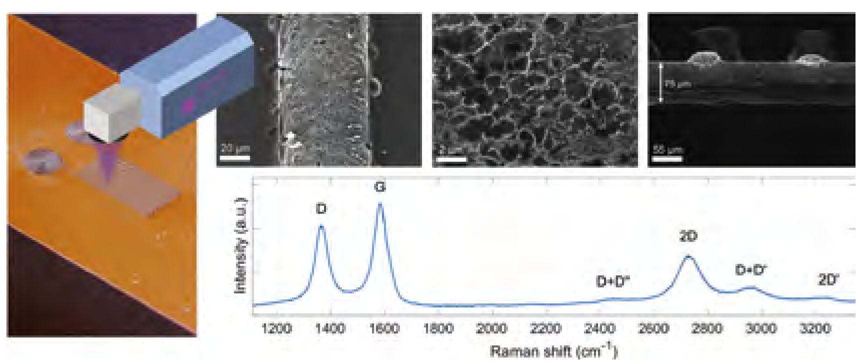

FIGURE 1
Sketch of the laser induced graphene strain sensors synthesis. Microstructural features and Raman spectroscopic evidence of graphene.

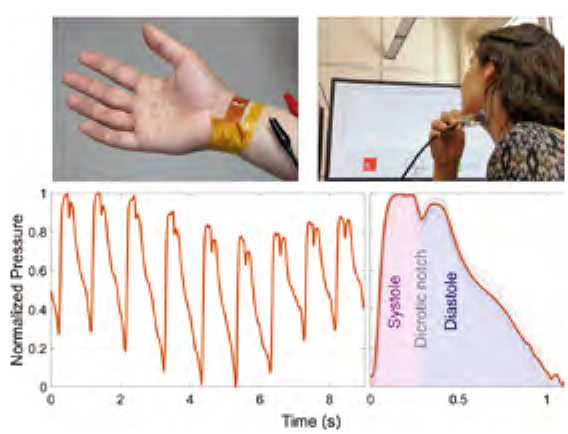

FIGURE 2
Arterial waveform pressure sensors based on laser induced graphene and their response.