Chemical Sensors Based on Laser Induced Graphene: Preparation, Process Optimization and Application

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Graphene has been the focal point of research for various applications since its discovery [1]. Thanks to their high electrical conductivity and high surface area, graphene-based materials have been utilized for the development of sensors such as chemical sensors that are sensitive to various chemicals like nerve gas or others [2]. Within this context, we have focused on the development of laser-induced graphene (LIG) by using different laser sources to fine tune and adjust the features of the graphene formed on the precursor material. Therefore, parameters such as laser source and power, processing speed and the process atmosphere are studied and adjusted. Prepared laser induced graphene samples on flexible substrates are analysed in terms of their chemical nature by using sophisticated analytical tools such as Raman microscopy and XPS. It was seen that the laser source and processing parameters are critical for the properties obtained. Purple diode laser was found to be more effective compared to carbon dioxide laser. The processing medium displayed a major change in the chemical nature of the graphene obtained as demonstrated by Raman scattering patterns obtained. Moreover, the electrical properties of the samples are also investigated and fine-tuned to match the requirements of the application targeted. It was seen that electrical resistivity decreases as the laser power increases. Graphitization of the carbon is also enhanced as seen from SEM images. Finally, the chemical sensing performance of the produced laser induced graphene samples are assessed by using a chemical stimulant. The effects of LIG process parameters and environmental conditions such as temperature and humidity on the sensing performance are assessed.

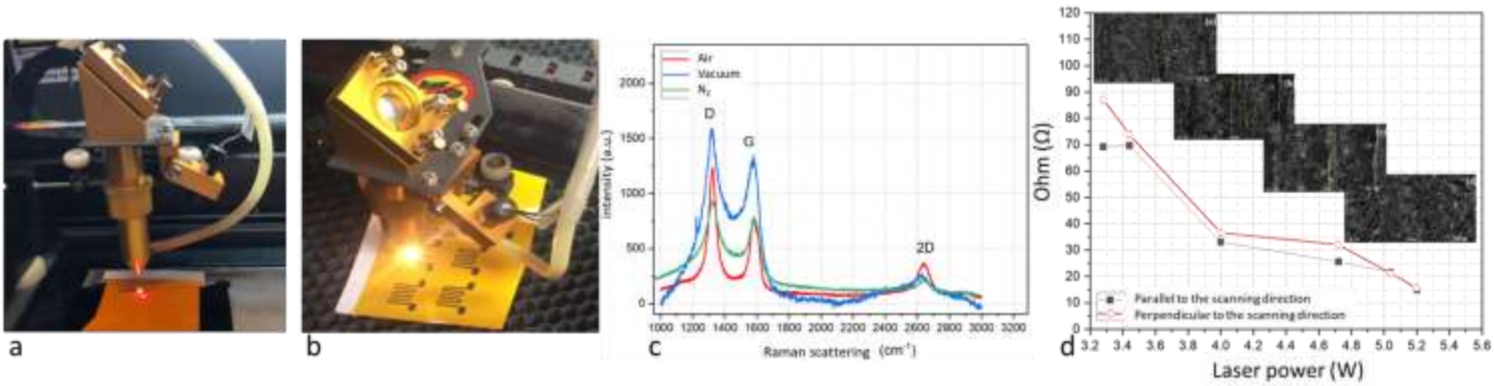

Figure 1: a) Purple diode laser setup used for the preparation b) Laser processing to produce LIG electrodes c) Raman scattering patterns obtained from the produced LIG samples under different mediums (air, vacuum and nitrogen) d) electrical resistance obtained as a function of laser power and measurement direction and SEM images obtained from the samples used for resistivity measurements

References

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