

## Laser photochemical synthesis of novel graphene oxide derivatives for organic electronics

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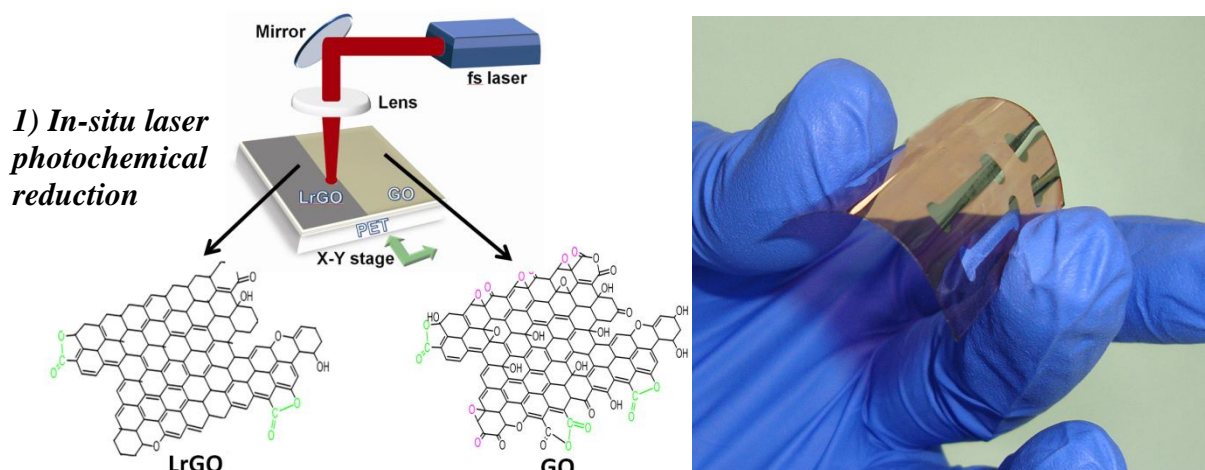
### Abstract

Photochemistry may provide novel ways to covalently modify materials, thus tailoring its electronic and chemical properties. Due to the unique physicochemical processes taking place during the ultrashort pulsed laser-matter interaction, the surface of nanomaterials can be activated, allowing the chemical reaction with different moieties present in the surrounding medium, giving rise to novel materials production. This paper will present our recent work on the application of pulsed laser radiation for the photochemical modification of graphene oxide (GO) nanosheets. In particular we report on a rapid and facile method for the simultaneous reduction, doping and functionalization of GO. This technique is compatible with flexible, temperature sensitive substrates and was initially applied for the efficient production of highly transparent and conductive flexible graphene-based electrodes [1]. It is based on the use of femtosecond laser irradiation for the in-situ, non-thermal, reduction of spin coated GO films on flexible substrates over a large area (Figure 1). Furthermore, we present a fast, non-destructive and roll to roll compatible photochemical method for the simultaneous partial reduction and doping of GO nanosheets through ultraviolet laser irradiation in the presence of reactive Cl<sub>2</sub> precursor molecules (Figure 2). By tuning the laser exposure time, it is possible to control the doping and reduction levels and therefore to tailor the work function (WF) of the GO-Cl derivatives from 4.9 eV to a maximum value of 5.23 eV, a WF value that matches the HOMO level of most polymer donors employed in OPV devices. Finally we demonstrate the pulse UV laser-assisted photochemical functionalization of GO with small molecules as an efficient technique to realize polymer electron acceptors (Figure 3). Potential applications of pulsed laser synthesized and modified materials in organic electronics, particular to bulk heterojunction organic solar cells are demonstrated and discussed.

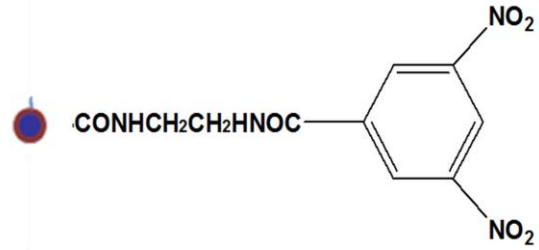
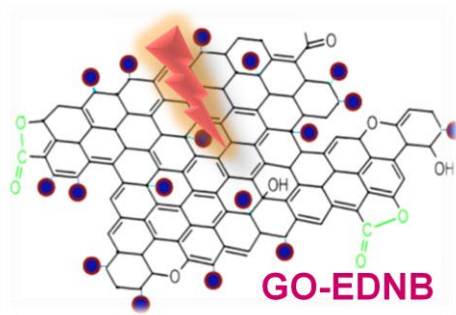
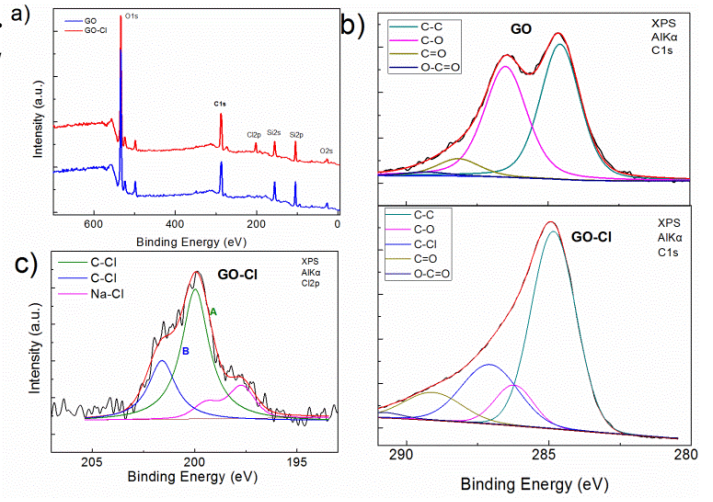
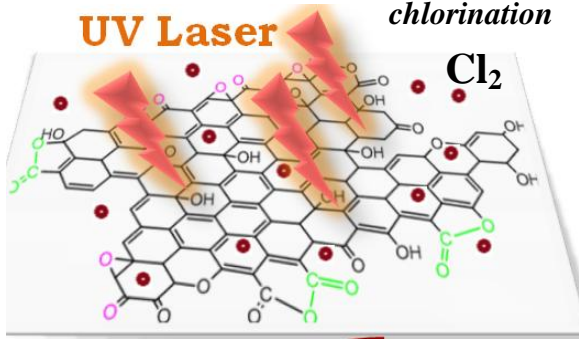
### References

[1] E. Kymakis , K. Savva , M. M. Stylianakis , C. Fotakis , E. Stratakis, Adv. Funct. Mater. 2013, 23, 2742-2749

### Figures



**2) In-situ laser photochemical chlorination**



**3) In-situ laser photochemical functionalization**

