SCALABLE PRODUCTION OF LOW-RESISTANCE GRAPHENE STRUCTURES THROUGH DIRECT LASER-INDUCED REDUCTION OF GRAPHENE OXIDE AT AMBIENT CONDITIONS

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ABSTRACT

Reduction of graphene oxide (GO) to a low-resistance product is one of the most versatile routes to obtain large volume graphene-based materials. A number of chemical and thermal methods are being applied to achieve this goal, albeit each one is bound to certain disadvantages and limitations. Two main requirements should be satisfied for a reduction method to be considered viable; obtaining enhanced electrical conductivity (partly related to the sp^3 to sp^2 transformation after removal oxygen-containing groups) and scalability of the process.

Laser assisted reduction has emerged as a promising method apt to overcome issues related to chemical and thermal reduction. Despite that a large number of efforts have been focused on laser-induced reduction of GO, its transformation to high quality reduced GO still remains a bottleneck. Here, it is shown that low-cost, millisecond lasers, widely used in the welding industry, achieve excellent reduction of GO to a product with the lowest sheet resistance yet reported by any laser-assisted method. Operation at ambient conditions, single pulse irradiation and a 2.60mm wide focusing spot, demonstrate the high potential of this approach to the scalability of the reduction process towards producing large volumes of high-quality reduced graphene oxide at low cost.

For comparison, GO is reduced by chemical and thermal methods. Raman and x-ray photoelectron spectroscopies are applied to investigate the underlying structural changes providing evidence for the removal of oxygen-containing species and defect healing.