Evaluation of fast thermal synthesis of reduced graphene oxides

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The exceptional properties of graphene and graphene-related materials (GRM) have aroused great scientific interest. High thermal conductivity, excellent mechanical properties, huge specific surface area and exceptional electronic conductivity, among other properties make graphene attractive for a large field of applications [1-4]. The synthesis of graphene is still limited due to the high cost and the low capacity of current production methods. These two factors make commercial applications few and limited to some areas. Since production methods of graphene and GRM define their properties and, as a result, their applications, the synthesis of GRM is currently a heavily researched topic. Also, production scalability is an issue. Hence, the production of graphene materials in large quantities is a main challenge. Thermal treatments of graphite oxides are considered as promising methods for the mass production of reduced graphene oxide (rGO). Production of rGO from graphene oxide (GO) requires a strong reduction procedure by thermal [5], chemical, photothermal [6], or electrochemical means. The proposed reduction methods should be optimized in order to obtain graphene materials through a low cost and nontoxic procedure suitable for a large-scale production. Using the preferential properties of graphene regarding the desired applications, six different thermal methods were tested for the rGO synthesis, using up to five different instruments for thermal treatment: a) an electrical furnace under standard air conditions (SAC), b) a microwave oven under SAC, c) a fusion instrument under SAC, d) a tubular reactor in an electrical furnace under a 100 mL min^{-1} Ar flow, and e) a hot-plate and a photothermal treatment employing an infrared laser.
The resulted samples were characterized by elemental analysis, X-ray diffraction (XRD), Brunauer-Emmett-Teller (BET) test and scanning electron microscopy (SEM). Elemental analyses show a better reduction factor in photothermal method (figure 1).

References

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Figures

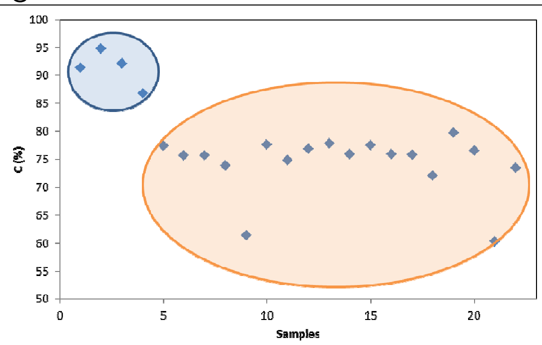

Figure 1: Reduction factor C (%) in photo-thermal (1-4) and thermal treatments (5-22).