

# Cost efficient washing and purification process for graphene oxide manufacturing at industrial scale

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Main approach for graphene oxide (GO) manufacturing remains still Hummers method, diversely modified in terms of process steps involved, deviation of conditions or chemicals used. However, still the most resources- and time-consuming step is washing of the as-synthesized sludge of GO and separation of pure graphene flakes from the possible waste of the chemical process. Producers are always faced with the contradictory choice between larger yield of graphene flakes and the quality of obtained material. Current methods for separation of pure GO are vacuum filtering or centrifugation, which proved to be applicable for small-scale academy research. However, none of these approaches is applicable for large industrial scale production of GO, due to complexity, low yield, and high labour costs.

We have developed the method [1] for washing of the as-synthesized GO paste, with step-by-step removal of i) acid, metals and other chemical contaminants ii) unreacted species of graphite (debris, rocks, 3D inclusions etc) and iii) flakes of GO thicker then 10 monolayers. The process involves dissolving and mechanical treatment of the GO paste, detaching the individual species from each other and separating them in space. Process is easily scalable (standard unit can be from current 10 g per batch to 1 kg) at low cost, has decent energy consumption and potentially may involve zero labour cost. Outcoming GO flakes are in dispersion, and the concentration can be tuned to the required level (e.g. from 0.01 20 mg/mL). Process depends negligible on the quality of incoming material and requires minor tuning of the system to supply the GO material accordingly to the ISO Standard on Graphene and Related Two-Dimensional (2D) Materials [2].

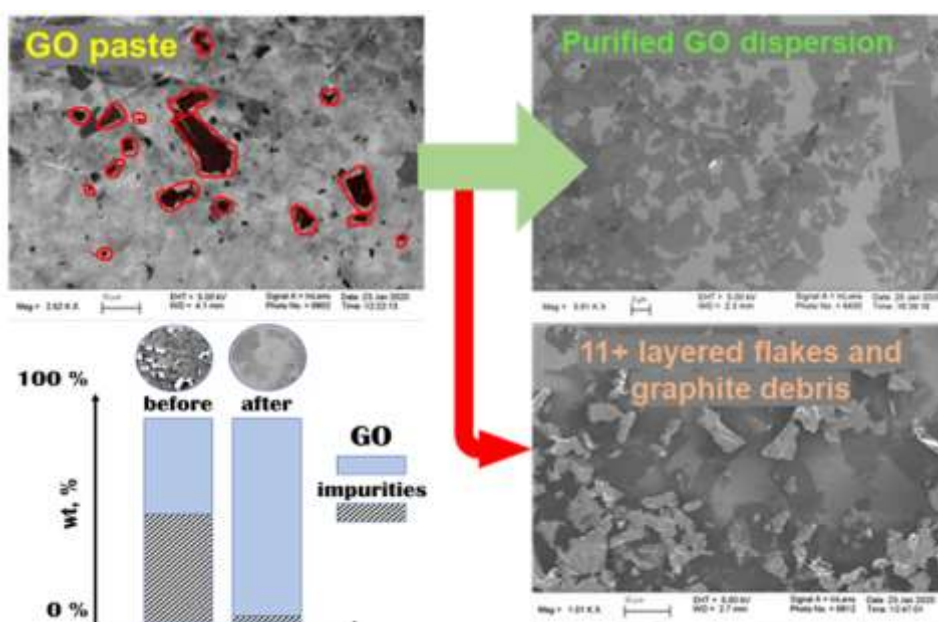
**Figure 1** shows the SEM images of incoming GO paste in comparison to the purified GO flakes after the process as well as content of removed “waste”; bottom left image visualises the efficiency of the process in terms of GO purity before and after the process.

## REFERENCES

[1] Patent Appl. No. 1950819-1 “Method for redistributing a flake material into at least two fractions” (pending, filed 28 June 2019).

[2] ISO. Nanotechnologies-Vocabulary-Part 13: Graphene and Related Two-Dimensional (2D) Materials [www.iso.org/standard/64741.html](http://www.iso.org/standard/64741.html) (2017).

## FIGURES



**Figure 1:** Illustration of the proposed method efficiency: SEM images of GO before and after the treatment, as well as separated “waste”.