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# THE IMPACT OF SONICATION ON GRAPHENE OXIDE'S PHYSICOCHEMICAL PROPERTIES AND NANOFILTRATION PERFORMANCE OF COVALENT CROSSLINKED MEMBRANES

Vepika Kandjou [1*], Jose M. Munuera [2], Beatriz Acevedo [1], Juan Ignacio Paredes [2] and Sonia Melendi-Espina [1]

[1] *Engineering, Faculty of Science. University of East Anglia, Norwich, England (UK)*
[2] *Instituto Nacional del Carbón, (INCAR), CISC, Apartado 73, 33080 Oviedo, Spain*

*Presenting author's e-mail: v.kandjou@uea.ac.uk

## Introduction

Fuelled by its ease of fabrication, hydrophilicity and chemical robustness, graphene oxide (GO) is emerging as a promising versatile next generation nanomaterial. This makes it a reasonable graphene substitute in several applications including separation membranes. Prior to fabrication into applicable thin films and membranes via dispersion-needing fabrication techniques, GO is often sonicated to enhance the individuality and dispersion of its nanosheets in aqueous and polar solvent solutions. However, it has been established that sonication comes with the alteration of the physical and chemical features of GO to an extent [1]. This study thus looks co-currently into the impact of preparatory GO sonication durations onto its physicochemical properties together with its impact on the nanofiltration performance of crosslinked GO membranes in water purification.

The establishment of a relation between the sonication duration of GO dispersion and the overall nanofiltration performance of the fabricated crosslinker was mainly significant in deriving the ideal sonication duration. This is further established through key characterisations of differently sonicated GO samples to determine the change in physical and chemical quality content of the samples as the sonication duration increases.

## Materials and Methods

GO powder was purchased from Graphenea (product code: C28/GOB02/Pw, Gipuzkoa, Spain). The membranes were supported by fibrous 0.2 µm pore sized, 47 mm diameter poly (acrylonitrile) (PAN) filter substrates from Sterlitech Corporation (Washington, USA).The crosslinker, p-phenylenediamine (PPD powder, product code: P6001) and methylene blue (MB, $C_{16}H_{18}ClN_3.3H_2O$, >99% purity; product code: M9140) were all purchased from Sigma Aldrich (Haverhill, UK). A bath type sonicator (Fisherbrand FB1505, Elmasonic S30H) was used to prepare samples under different sonication durations (30, 60, 120 and 180 minutes).

Following the PAN substrate pre-treatment, crosslinked membranes were fabricated using the schematic in figure 1;

Membrane performance for each of the fabricated membranes on the other hand was evaluated by the separation of 10 mg/l of methylene blue solution in a homemade lab scale nanofiltration device.

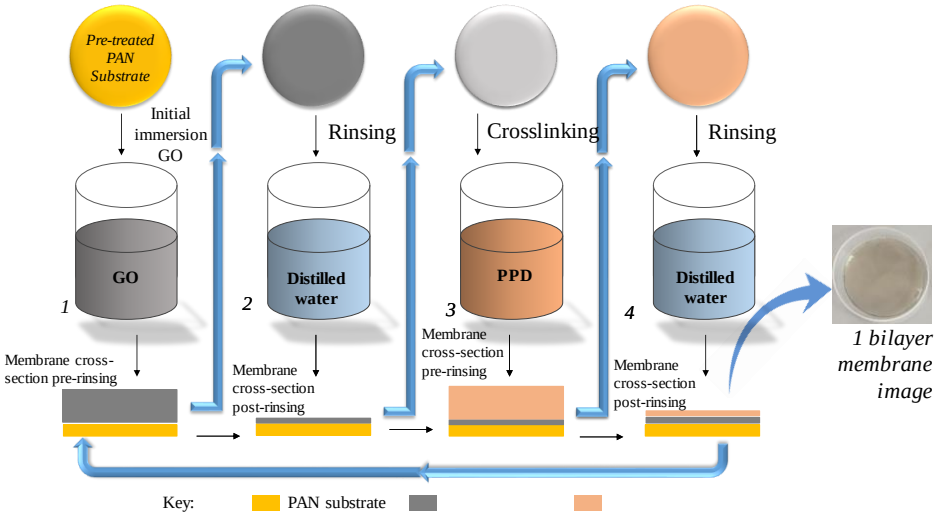


**Figure 1. Dip-assisted layer by layer fabrication schematic**

## Results and Discussion

A general relation between sonication duration and change in the physicochemical properties of GO was established. An alteration of the epoxy and carboxylic functional groups composition in GO was also observed with increasing sonication duration. Physically, a reduction in lateral size and aspect ratio of the fabricated GO nanosheets was observed with increased sonication time. The influence of sonication onto the performance of the membranes is apparent and up to 98.2% rejection of MB was achieved at longer sonication time relative to only 59.8% for the unsonicated samples (figure 2).

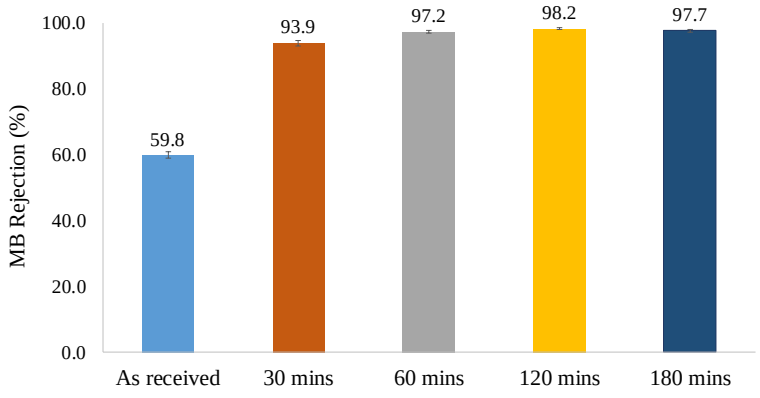


**Figure 2. Methylene blue rejection of the differently sonicated membranes**

## Conclusions

Successful fabrication of differently crosslinked membranes to determine optimum sonication duration was achieved. Membrane performance increased with an increase in sonication duration plateauing at 60 minutes of sonication.

## Acknowledgment

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## References

1. J. Kim, et al, "Impact of size control of graphene oxide nanosheets for enhancing electrical and mechanical properties of carbon nanotube-polymer composites," *RSC Adv.*, vol. 7, no. 48, pp. 30221–30228, 2017.