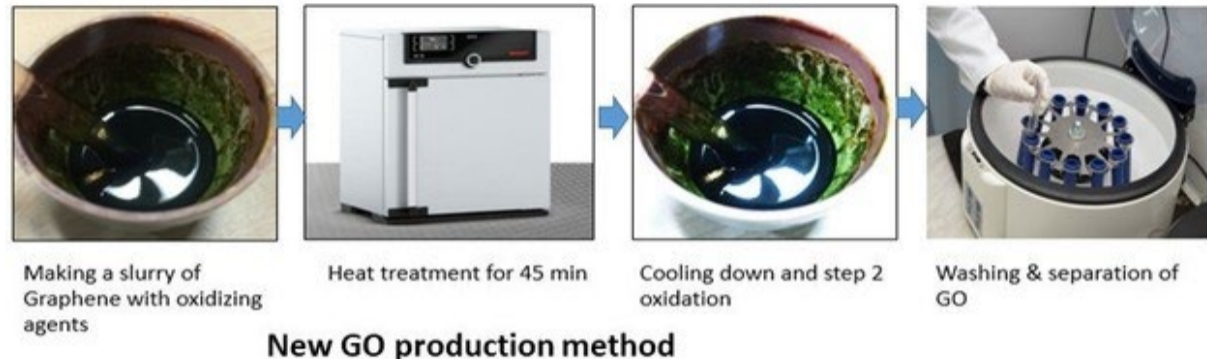


Fast and easy synthesis of large-scale graphene oxide from graphene via thermal treatment

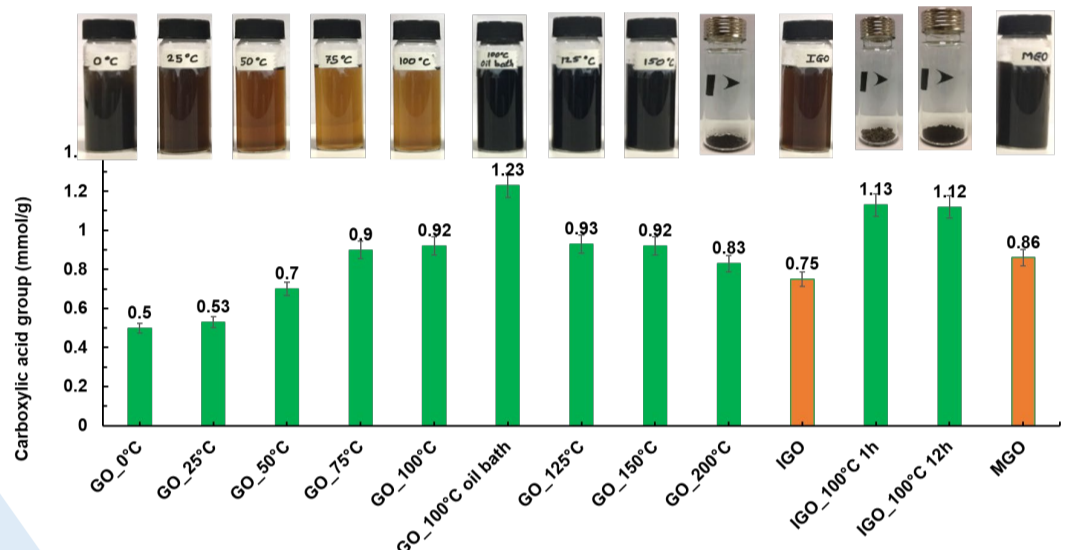
Technology Overview

Graphene oxide (GO) is a key product segment in the graphene market which will account for around 40% of the total industry revenue share in 2024. However, the high cost of GO is limiting the application.

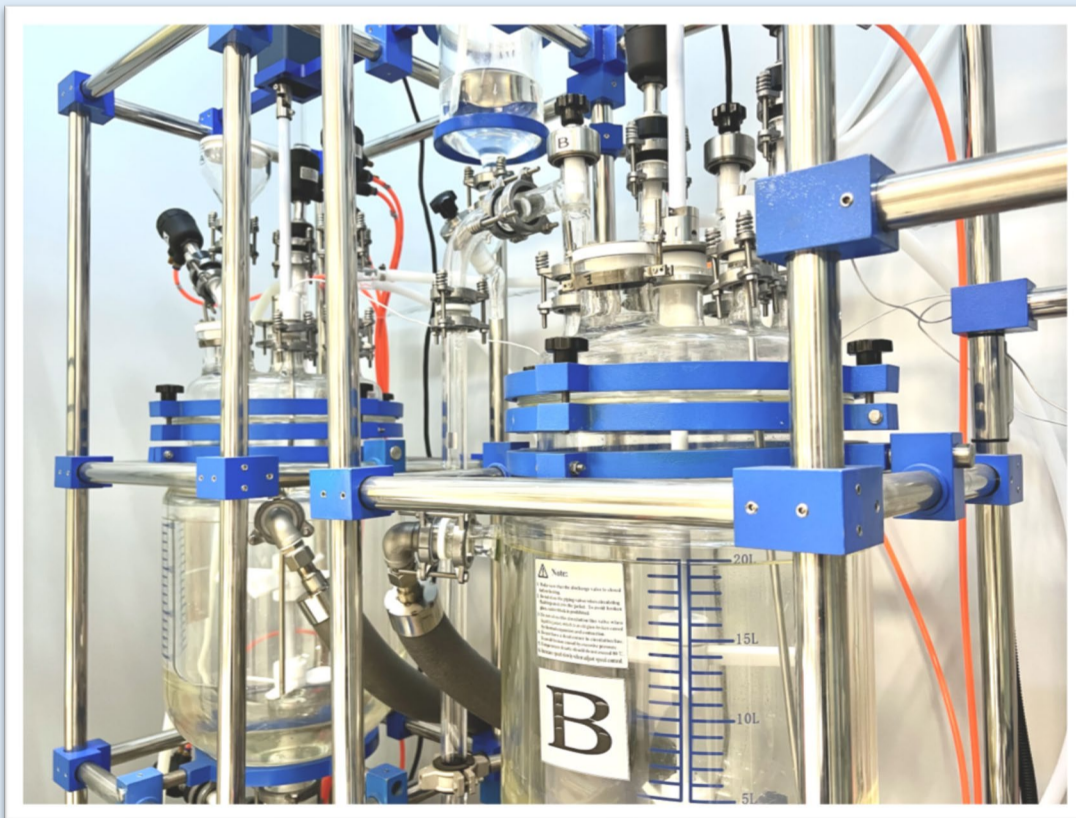
The current methods of GO production has a few limitations, such as long oxidation time, formation of defects (poor quality), large volume of acid usage, toxic gas evolution, etc. The high cost of GO is mainly associated with the complex and tedious oxidation processes as well as the huge volume of chemicals used. This technology offers a simple, fast and eco-friendly method of producing GO.



New GO production method



Yield & dispersion stability of GO produced under different condition



Semi-automated GO production system with a capacity of 100g per batch

Key Features & Benefits

- Simple & easily scalable method of GO production
- Fast process (Reduced reaction time)
- High quality GO production
- Less chemical usage
- Eco friendly production process (no toxic NO₂ gas evolution)

Potential Applications

- Coatings/Adhesives/ Composites
- Sensors & Electronics
- Energy storage devices
- Additives for Membrane
- Textiles
- Automotive parts fabrication

Opportunities for collaboration

- Semi-automated GO production system available for collaborative work in GO synthesis

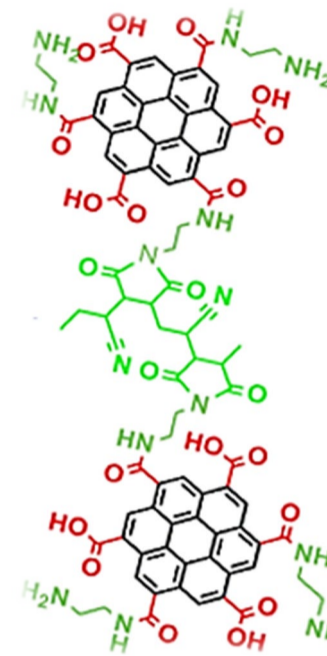
Ultra-wetting Graphene-based Ultrafiltration Membrane

Technology Overview

In recent years, graphene has gained much attention in the field of membrane science and engineering due to its high surface area, mechanical strength and chemical stability. Theoretical analysis predicted that graphene-based membranes may exhibit 2-3 orders of magnitude higher permeability than the current state-of-the-art membranes.

EWT COI's patented ultra-wetting graphene-based membrane has been developed with a unique method that facilitates the easy scalability of this membrane. To do so, EWT COI has chemically-grafted GO to a polymer backbone to create a polymer composite.

The membrane with improved hydrophilicity can operate at lower pressure, thereby reducing as high as 20-50% of the overall energy consumption. Membranes are robust and able to resist fouling and thereby reduce the frequent cleaning requirement, chemical usage, and downtime. It can be used for all ultrafiltration applications such as pre-treatment to RO, potable water treatment, produced water treatment etc.



Functionalized GO

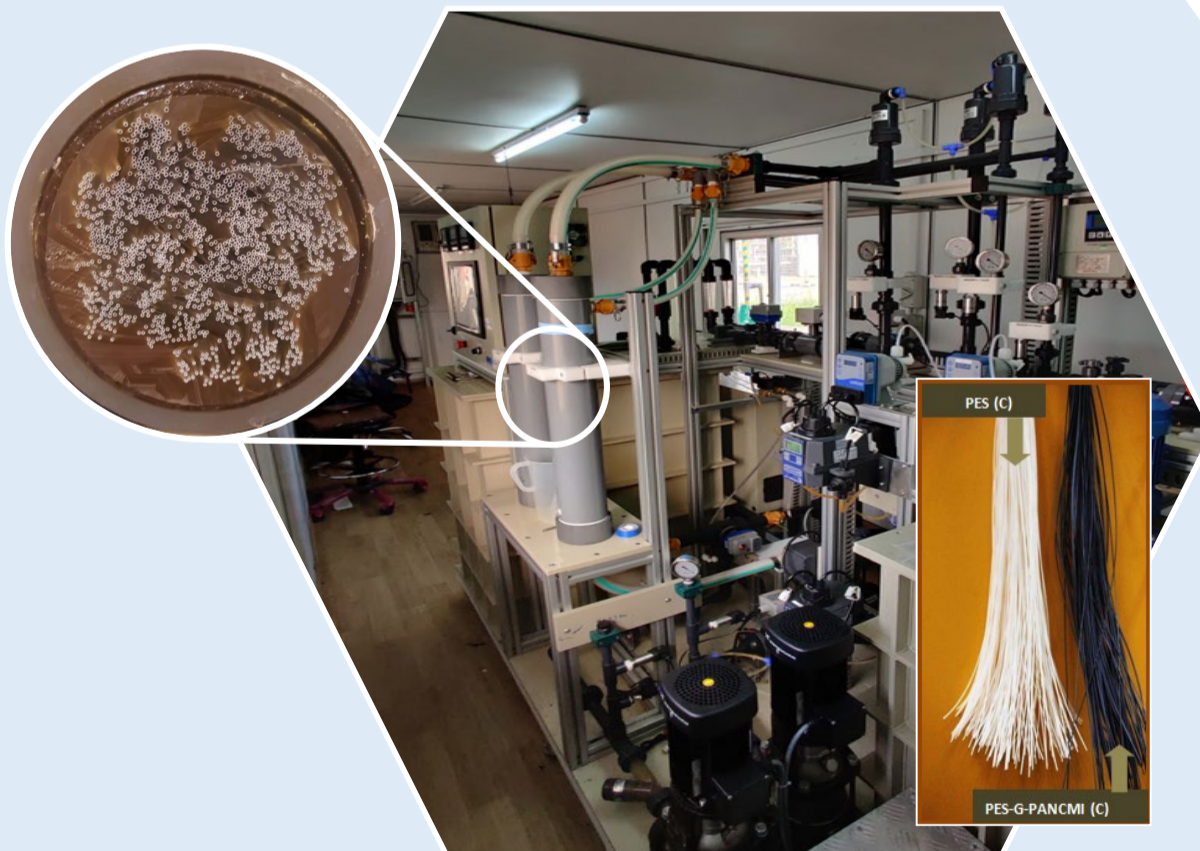


Polymer composite

Functionalized graphene based ultrafiltration (UF) membrane



(10) International Publication Number
WO 2016/171615 A1



Pilot system (25-50 m³/d) with 4" membrane module tested at PUB R&D facility at 40 LMH, 90% recovery

Key Features & Benefits

- High permeable membrane
- Operates at lower pressure
- Resistant to fouling
- Chemically & Mechanically stable
- Reduced Cleaning & downtime
- Reduced overall operating cost (~20%)

Potential Applications

- Pre-treatment to RO
- Potable water filters
- Industrial water treatment
- F&B Process & separation
- Protein separation

Opportunities for collaboration

- Industry partners (membrane manufacturers or system integrators with capabilities to scale-up the membrane) who can bring this technology to market by licensing this technology.
- Partners who can further improve the dispersion of the polymer composite.

Graphene Based Thin Film Composite Membrane

Technology Overview

Nanofiltration (NF) is typically used in surface water (e.g., colour, total organic carbon removal) or ground water treatment (e.g., hardness removal). NF has also found other applications (e.g., Food and Beverages, Chemical/Petrochemicals, Pharmaceutical/Biomedical, textile etc).

Like reverse osmosis (RO) membrane, NF membranes typically have a polyamide selective layer formed using interfacial polymerization, which allows the membrane to reject components such as multi-valent salt, dye etc. However, the cross-linkages in conventional thin film composite (TFC) layer can be deactivated with repeated chlorine dosing, resulting in reduced rejection over time.

EWT COI has developed a nanofiltration membrane with fully functionalized graphene oxide based TFC for separation processes. It can also be used for demineralisation, dye-salt fractionation, and macromolecular sieving in pharmaceutical, chemical and dairy industries.

Functionalized graphene based TFC membranes for NF/RO applications



WIPO | PCT



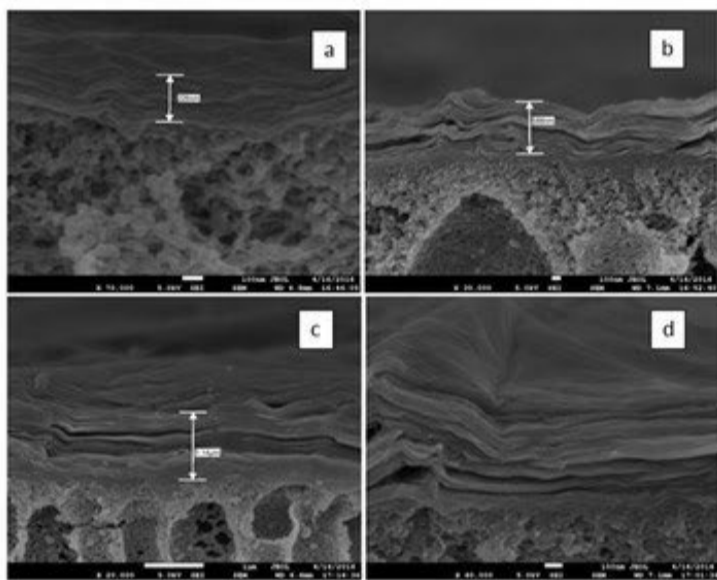
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WO 2016/171622 A1

Key Features & Benefits

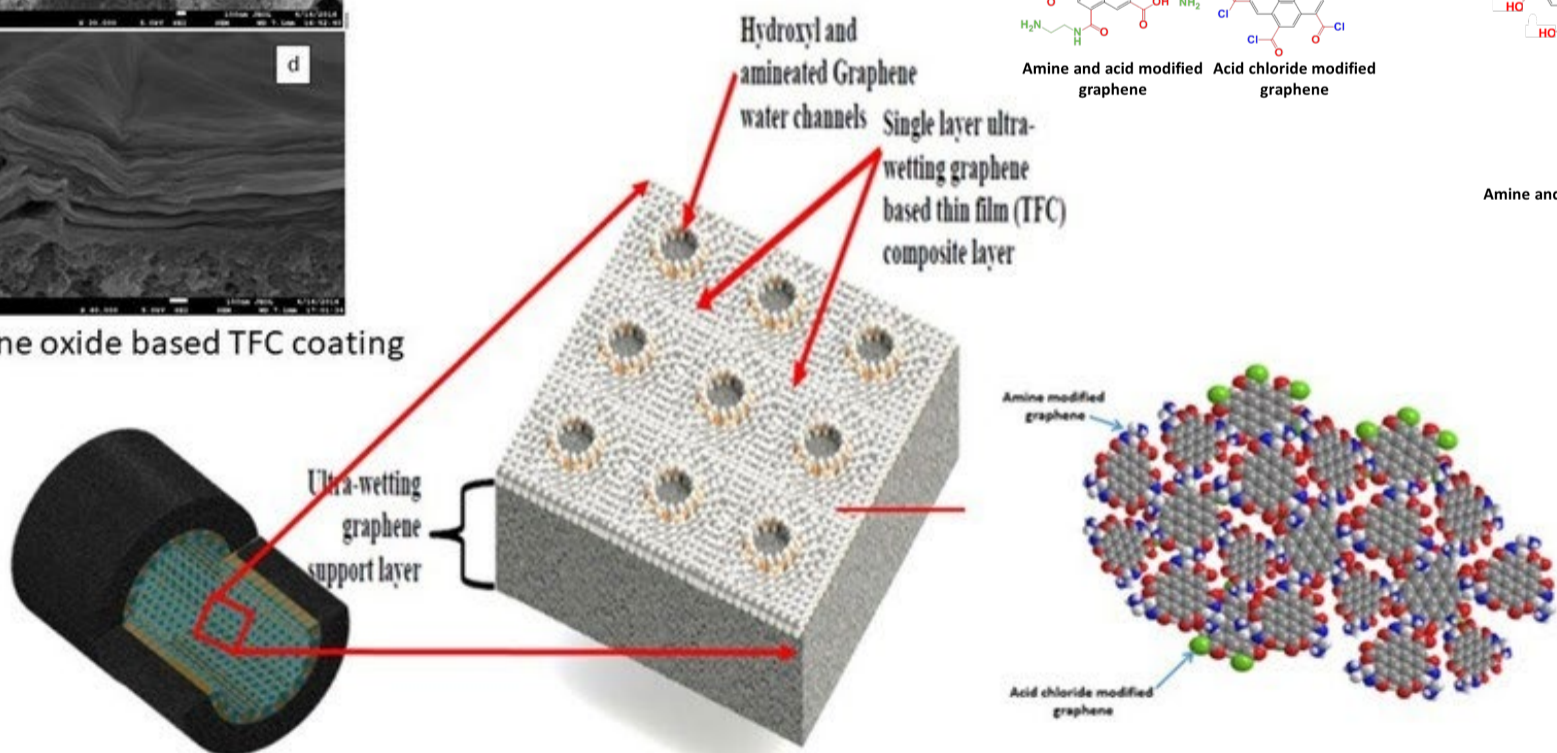
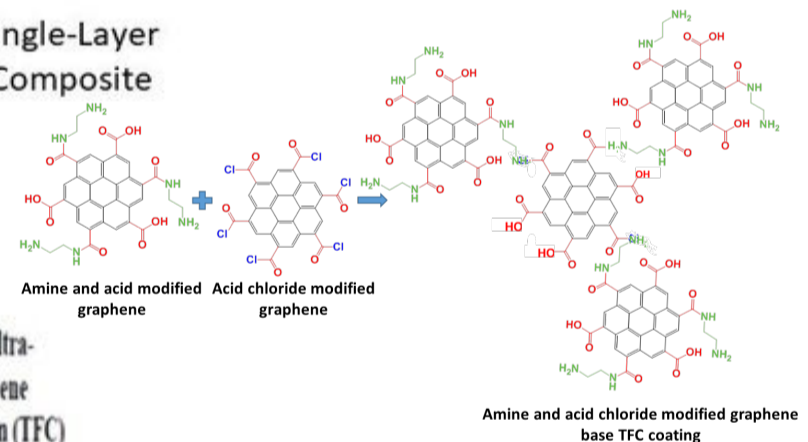
- Fully functionalized GO based TFC membrane
- Flexible to coat onto flat sheet & hollow fiber
- Potentially higher chlorine resistance

Potential Applications

- Pre-treatment to RO (to reduce load)
- Dye-salt fractionation
- Industrial water treatment
- F&B / Pharmaceutical
- Product separation & concentration



Picture for Functionalized Single-Layer Graphene-Based Thin Film Composite



Schematic representation of graphene oxide based TFC coating

Opportunities for collaboration

- Industry partners to license the technology and to bring the technology to market.
- Collaborators to further improve the defect-free TFC layer and bring this technology to the next level.