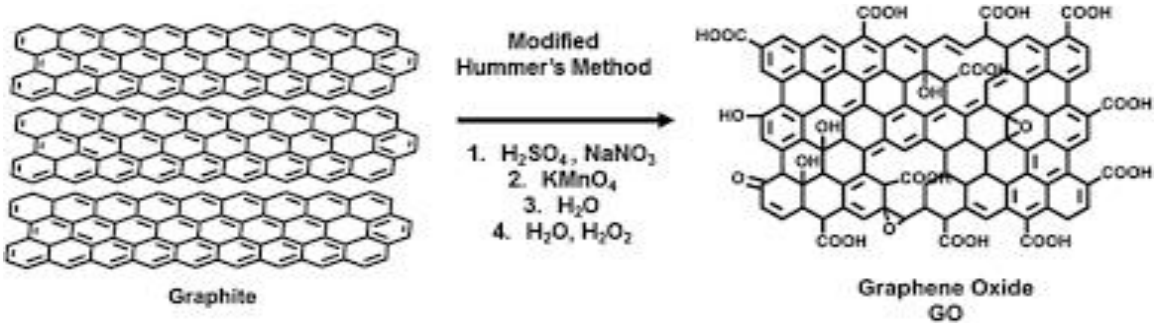
Garphene Oxide

Graphene oxide is a single-atomic-layered material consisting of carbon, oxygen, and hydrogen atoms arranged in a two-dimensional honeycomb lattice structure. Graphene oxide is created by the oxidation of graphite, the same material used in pencil lead, using strong oxidizing agents. This oxidation process introduces oxygen-containing functional groups, such as hydroxyl (-OH), epoxide (-O-), and carboxyl (-COOH) groups, onto the graphene sheets.



Preparation of GO

1. **Graphite oxidation:** The starting material of the modified Hummers method is graphite, which is oxidized using a mixture of phosphoric acid and sulfuric acid in the ratio of 1:9 and potassium permanganate and graphite added in the ratio of 6:1 in an ice bath.

2. The reaction mixture is then heated to 50 ^{0}C and stirred for 12 hours and cooling down to room temperature followed by addition of 30% of H2O2 to remove excess of KMnO4.

3. This reaction results in the formation of graphite oxide and other byproducts, such as manganese diaoxide and potassium sulfate.

4. Exfoliation: The graphite oxide produced in the first step is exfoliated by stirring the mixture, which causes to form the single atomic layered graphene oxide which will easily dispersed in the solution.

5. Filtering and washing: The exfoliated GO is then filtered to remove the solid byproducts and the remaining solution is washed with water to remove any residual oxidizing agents.

6. Drying: The washed GO solution is the dried using evaporation or vaccum drying at 80 ^{0}C for 24 h to produce a dry GO powder.

Properties:

1. **High Surface Area:** Grapheme oxide possesses a large surface area of 2418 m^2/gr makes it suitable for various applications, including energy storage, catalysis, and sensors.

2. **Hydrophilicity:** The presence of oxygen functional groups on the surface of graphene oxide makes it highly hydrophilic which disperse readily in water and forms stable colloidal suspensions, enabling its use in aqueous-based applications.
3. **Electrical and Thermal Conductivity:** the electrical conductivity of graphene oxide is less than a micro siemens/m due to the disruption caused by oxygen functional groups and the thermal conductivity of GO is very low and alomost behaves like non-conductors.
4. **Mechanical Properties:** it possesses good mechanical strength compared to many other materials. The young's modulus value for GO is 380 to 470 GPa.
5. **Optical Properties:** GO exhibits light absorption over a broad range of wavelengths, from ultraviolet (UV) to visible light, making it useful in applications such as photodetection and solar cells.
6. **Chemical Reactivity:** Graphene oxide offers a high degree of chemical reactivity as a catalyst in various chemical reactions due to the presence of oxygen functional groups.

Applications:

1. **Energy Storage:** Due to the large surface area and electrical conductivity GO has been explored for use in supercapacitors and batteries.
2. **Water Purification:** The layered structure of GO allows for the selective passage of water molecules while blocking the passage of ions and larger molecules, making it an effective barrier material in water filtration and desalination processes.
3. **Sensors:** Graphene oxide-based sensors have demonstrated excellent sensitivity and selectivity for detecting various analytes such as in gas sensors, biosensors, and environmental monitoring.
4. **Biomedical Applications:** GO can be used as a drug delivery vehicle, due to its ability to encapsulate and release therapeutic agents. GO has also shown potential in tissue engineering, biosensing, bioimaging, and cancer therapy.
5. **Catalysis:** The oxygen functional groups on GO's surface can act as active sites for catalytic reactions, enabling efficient and selective transformations in areas such as organic synthesis and fuel cells.
6. **Photovoltaics:** Its high optical absorption, tunable bandgap, and ability to transport charge carriers make it a potential candidate for efficient light harvesting and energy conversion.