GRAPHENE
FLAGSHIP

Graphene Flagship Production

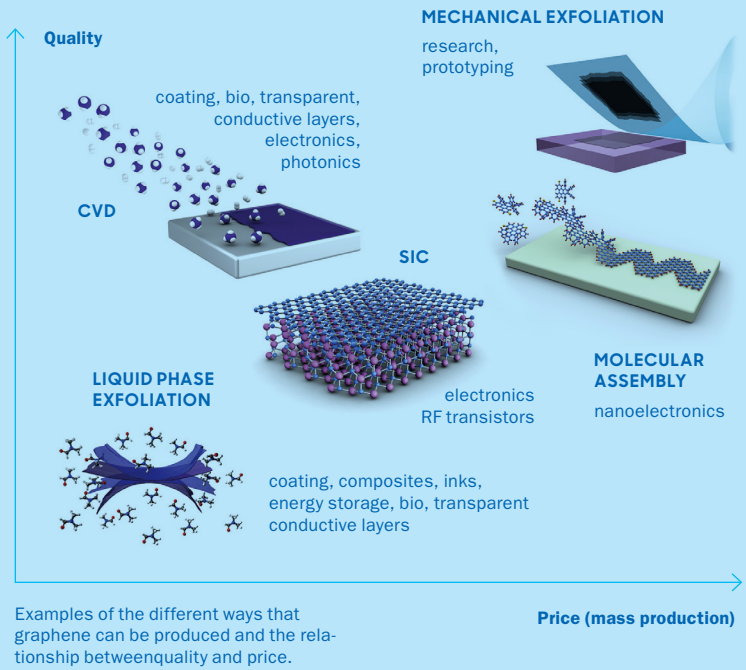
Graphene is part of a whole family of related materials, each with its own properties and applications.

Funded by
the European Union

A FAMILY OF MATERIALS

Graphene is part of a whole family of related materials, each with discrete properties and applications. Different types of graphene are produced and processed in different ways.

1. Graphene oxide is the product of liquid phase exfoliation by which monolayers or few layer flakes of graphene are exfoliated from graphite in a liquid medium.Graphene oxide is an important material for a range of applications in biomedicine, energy storage, nanocomposites and others.
2. Graphene crystals are grown on a variety of substrates for varying applications. Graphene grown on insulators, such as SiO2, typically produces a film with small crystallites, whereas growth on the close-packed surfaces of metals yields highly crystalline films. These crystals can be grown on wafers for electronic applications.
3. Chemical Vapour Deposition (CVD) graphene is produced through a process by which carbon atoms are evaporated and then deposited on copper foil. CVD graphene can be used for applications like transparent and flexible electronics as well as anti-corrosion coatings.



Examples of the different ways that graphene can be produced and the relationship betweenquality and price.

GRAPHENE PRODUCTS BY THE GRAPHENE FLAGSHIP

Graphene Flagship partners and associated members produce a wide range of graphene products. Here are just a few:

Graphene films on wafer
- Produced by Chemical Vapor Deposition (CVD) allows for mass production.
- Used mainly in electronic applications
- High Electron Mobility graphene
- Already integrated in electronic devices production processes

Graphene Flagship partner Graphenea produces three sizes of graphene wafers at a scale of thousands per year:
- 4000 8” wafers/year
- 1000 6” wafers/year
- 1000 4” wafers/year

Graphene Flakes
- Produced by several industrial exfoliation methods
- Available in bulk quantities
- High surface area material allows for low loadings
- Versatile material that can be used in composites, inks, energy storage,among others
- Available in powder format, dispersed in solvents and already dispersed in different matrices

In addition to wafers, Graphenea produces 250 tons of graphene oxide; graphene dispersed in a solvent, per year.

Graphite Electrodes
TALGA, a Graphene Flagship associated member, manufactures graphene products
- Graphene and other graphitic products are used in Li-ion battery anodes and cathodes
- Allow fast charging, high power, safer low temperature performance, corrosion protection of current collectors
- Si-enhanced anode material will increase Li-ion battery capacity in mWh/g
- Na-ion batteries are a potential future replacement for Li or lead acid batteries in cars

Graphene Inks
- Low-cost graphene inks can replace metal inks for printed circuits in a wide range of smart devices
- Flexible circuits and sensors will lead to the development of smart connections and the Internet of Things
- Graphene based inks give printed textiles added functionality of touch sensors and circuits

Graphene Flagship partner Graphene-XT produces conductive GXT-ink, suitable for printing special geometric paths on different types of substrates.

Roll to Roll Deposition System
Graphene Flagship partner AIXTRON’s Neutron is the first roll to roll system capable of depositing large area graphene onto metal foils under ambient conditions. Since the Neutron does not require a vacuum, it can be easily placed inline at manufacturing, enabling truly cost-effective graphene production.

Graphene Market
The Graphene Flagship’s principal mission is to take technologies based on graphene from the laboratory to commercial applications. The full-scale application of graphene in commercial products is still several years in the future, which means there is time for Europe to secure a major role in this ongoing technological revolution in a market that is expected to grow from €778.7 million in 2021 to €7,163.2 million by 2028.

Graphene Producers

Aixtron	aixtron.com
Avanzare	avanzarematerials.com
BeDimensional	bedimensional.som
Graphene-XT	graphene-xt.com
Graphenea	graphenea.com
Graphenest	graphenest.com
Graphensic	graphensic.com
Graphitene	graphitene.com
Graphmatech	graphmatech.com
Grupo Antolin	grupoantolin.com
Nanesa	nanesa.it
Sixonia Tech.	sixonia-tech.de
TALGA	talgaresources.com
Thales	thalesgroup.com/en
Versarien	versarien.com

For more info visit
graphene-flagship.eu

The Graphene Flagship is research, innovation and collaboration

Funded by the European Commission, the Graphene Flagship aims to secure a major role for Europe in the ongoing technological revolution, helping to bring graphene innovation out of the lab and into commercial applications. The Graphene Flagship gathers over 170 academic and industrial partners from 22 countries, all exploring different aspects of graphene and layered materials.

Bringing diverse competencies together, the Graphene Flagship facilitates cooperation between its partners, accelerating the timeline for industry acceptance of graphene technologies. The European Commission's FET Flagships enable research projects on an unprecedented scale. With €1 billion budgets, the Graphene Flagship, Human Brain Project and Quantum Flagship serve as technology accelerators, helping Europe to compete with other global markets in research and innovation.

With an additional €20 million investment, the European Commission has now funded the creation of an Experimental Pilot Line for graphene-based electronics, optoelectronics and sensors.

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