Graphene technology for innovation in coatings and composites

Stefano Borini - Graphitene Ltd (UK)

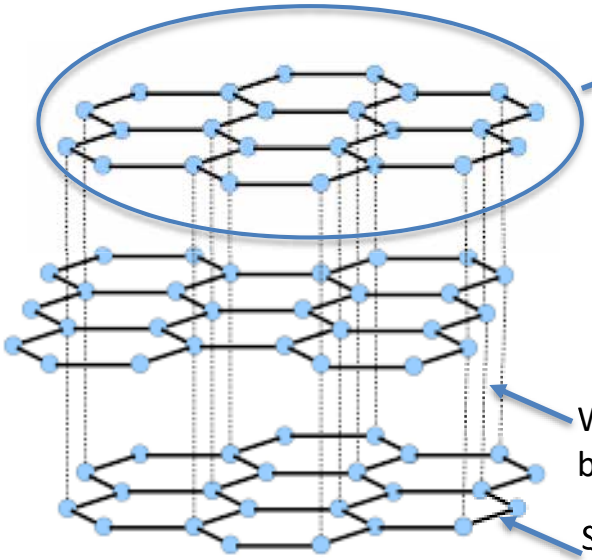
RAMSPEC 2016

GRAPHITENE

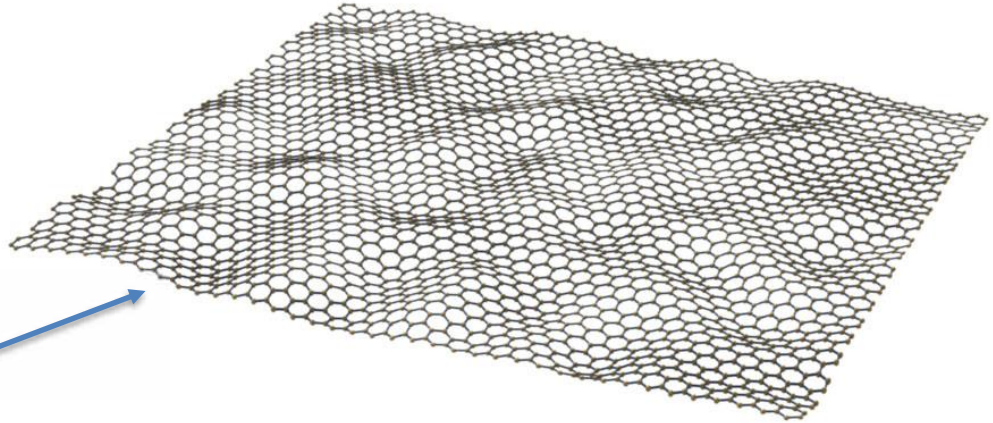
azelis

What is graphene?

Graphite



Graphene



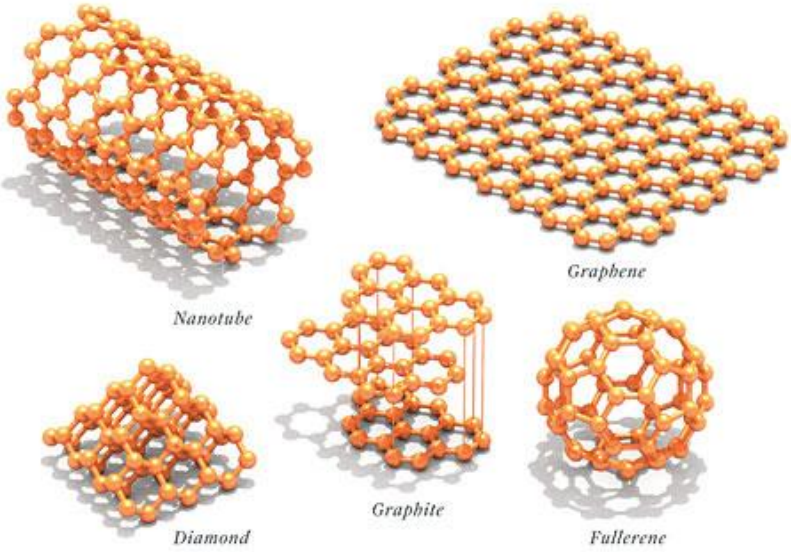
Atomically thin sheet

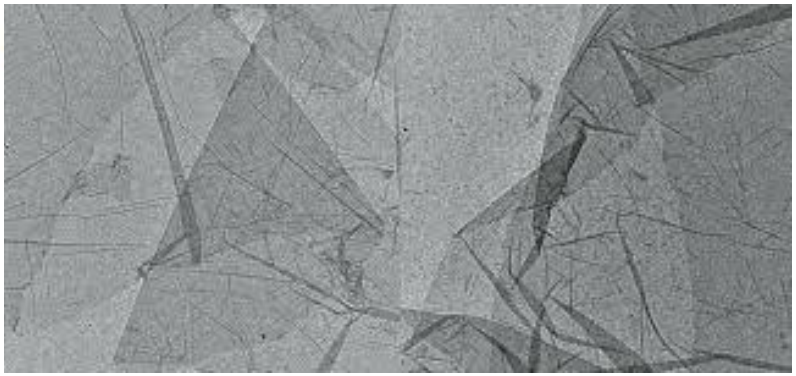
All-surface material

Strong and flexible

Unique among Carbon additives

Planar Form





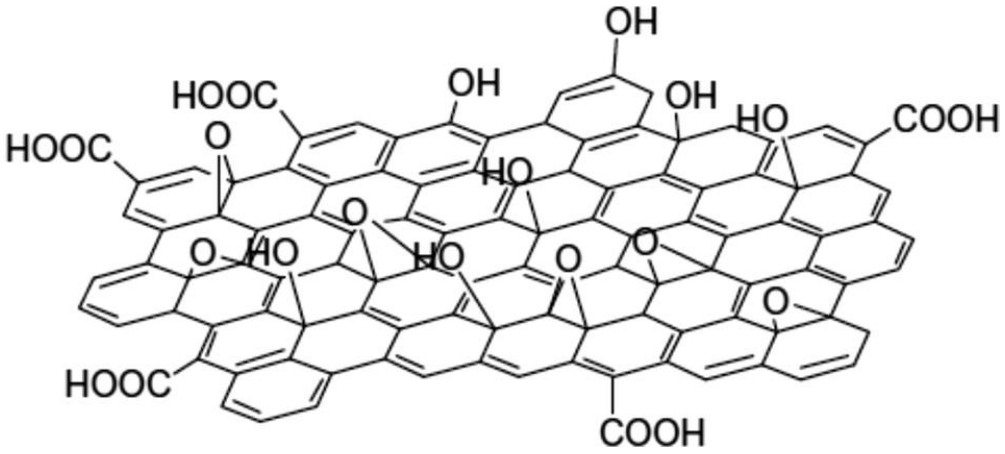
High surface area

Exceptional properties & multi-functionality

- 200 times stronger than steel
- More electrically conductive than copper
- More thermally conductive than diamond

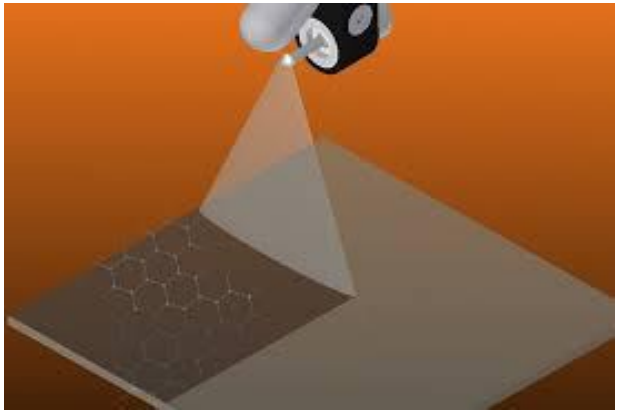
Graphene in industrial materials

Various graphene grades



Functionalisation
→ Interaction with the matrix

Inks



Coatings

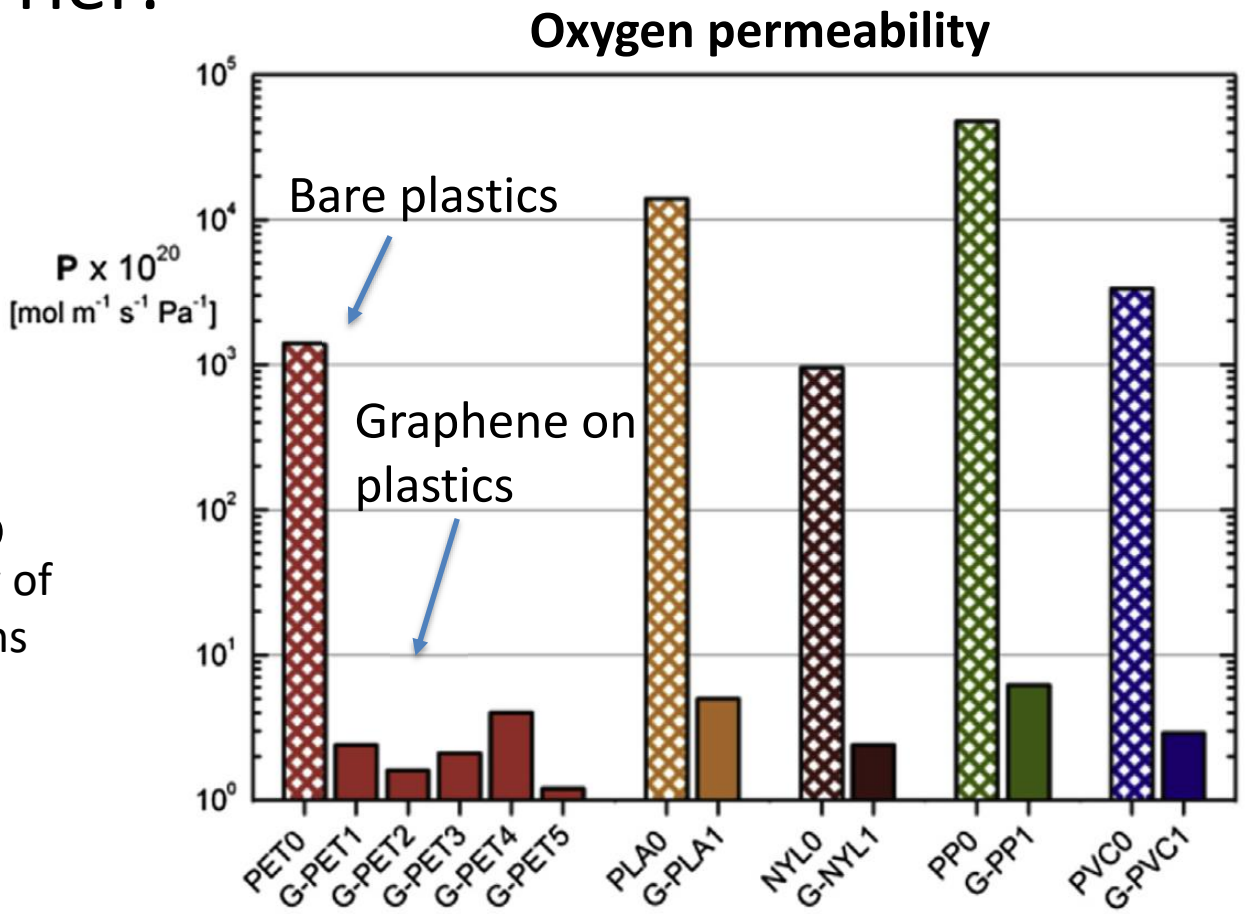
Composites

Graphene Coatings

Impermeable barrier:

95%
Reduction of PET oxygen permeability

100 times
lower than water permeability of industry-standard barrier films (aluminized PET)

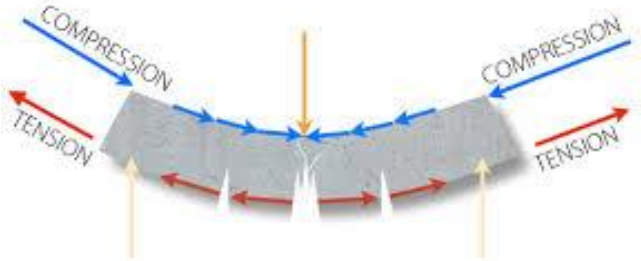


[From: D. Pierleoni et al., *Carbon* 96, 513-512 (2016)

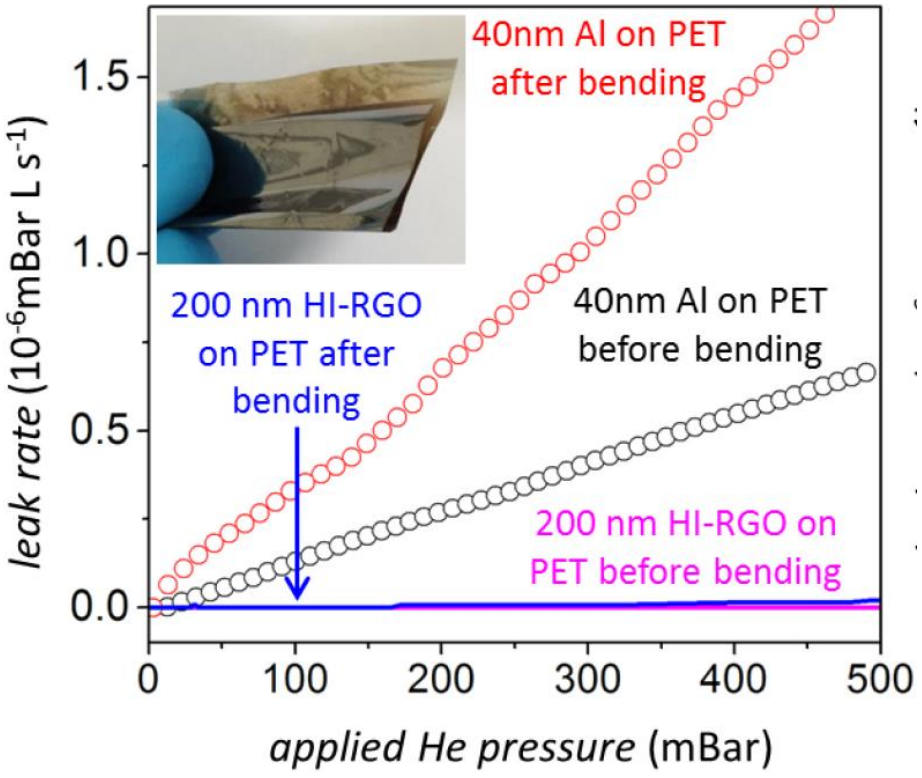
Graphene Coatings

Wear resistant:

Scratch resistant



Fatigue resistant / Flexible



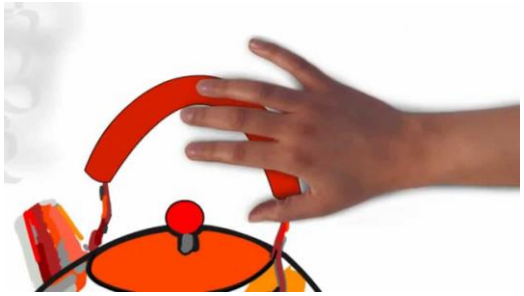
[From: Y. Su et al, Nature Commun. (2014) DOI: 10.1038/ncomms5843]

Graphene Coatings

Multi-functional:

Anti-bacterial

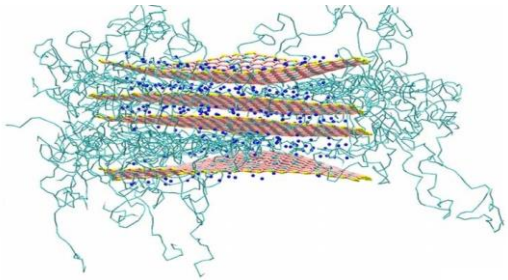
Flame retardant



Thermal conductivity

Electrical conductivity

Graphene Composites



Thermoplastics

Polymers: PET, PP, PPS, Nylon, PS, PVC

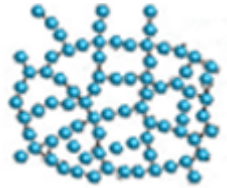
Graphene loading range: 0.05 – 2 wt%

Tensile strength increase: 16 – 130 %

Young's modulus increase: 42 – 100 %

Improved thermal stability,
increased thermal decomposition T,
increased thermal conductivity

Thermosets



Polymers: Epoxy resins, Polybutadiene, Polyurethanes, Polyimides

Graphene loading range: 0.4 – 3 wt%

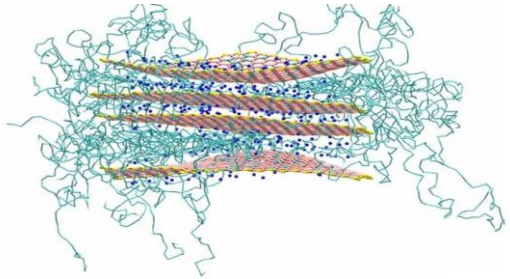
Tensile strength increase: 40 – 239 %

Young's modulus increase: 30 – 87 %

Storage modulus increase 60 – 200 %

Improved thermal stability

Graphene Composites



Example of applications: Aerospace and automotive

Graphene-reinforced materials can:

- Reduce weight, thus saving fuel and operation costs
- Improve performance, such as crack-resistance
- Withstand wide temperature variations
- Provide electrical conductivity for lightning strike protection and EMI shielding of electronic components

About Graphitene

GRAPHITENE

- Leading graphene manufacturing company in Europe, founded in 2012
- HQ in London, manufacturing plant in North Lincolnshire, and R&D offices in Trondheim (Norway) and Tartu (Estonia)
- Focus on large volume high-quality production tailored to individual customer needs
- Full range of carbon nanomaterials: graphene, GO, rGO, graphites, expanded graphite, doped and microporous graphene, admixtures
- Azelis: exclusive distributor in Italy

azelis

Graphitene technology

Graphite rocks/ores

one-step process

scalable, fast, green

Graphitene materials

- Large scale production
- High quality and quality control
- Long-terms exclusive agreements in place for graphite supply
- In-house nanotech expertise for materials functionalization

Graphitene products

- **Graphites:** High purity graphite and expanded graphite flakes

- **Graphene Platelets:** High quality few-layer graphene flakes

- **Graphene Oxides (GO):** High quality monolayer GO and reduced GO flakes

- **Functionalised graphene:** Graphene flakes with engineered surface for optimal interaction with matrices

- **Graphene admixtures:** Graphene-based blends formulated for specific applications (for ex. batteries, construction, etc)

A team of experts select the best solutions for our customers needs

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