Graphene: from synthesis to the tailoring

Colomer, Jean-François; Henrard, Luc; Lambin, Philippe; Pireaux, Jean-Jacques; Sporken, Robert

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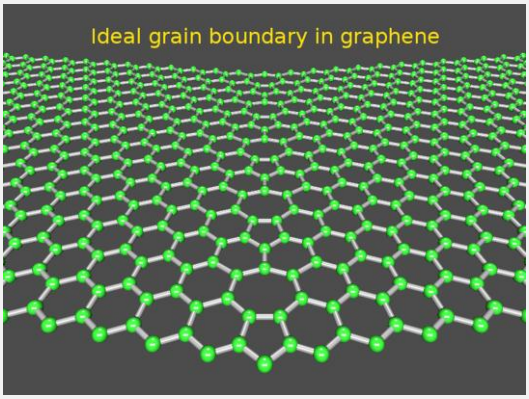
Graphene, from synthesis to the tailoring of its properties

Senior scientist(s)

- Jean-François COLOMER
- Luc HENRARD
- Philippe LAMBIN
- Jean-Jacques PIREAUX
- Robert SPORKEN

Research Field and Subjects



Graphene is a truly two-dimensional crystal composed of carbon whose atoms form a chicken-wire like network with strong covalent bonds. Graphite is a piling of almost infinitely many graphene sheets bound together by weak van der Waals forces. Many interesting properties of graphene put this material at the foreground of present day nanosciences. Graphene is mechanically hard, extremely flexible, chemically inert, impermeable to any atom and molecule, optically transparent. It is a zero-gap semiconductor easily made conducting by electrostatic charging, the charge carriers having then a remarkable mobility, and it has an excellent thermal conductivity. The electronic properties of graphene depend strongly on its environment, which makes it a good candidate for sensing. Initially isolated from graphite by skillful exfoliation, then obtained by annealing of carbon terminated (0001) face of SiC, graphene is most commonly produced today by thermal decomposition of hydrocarbon molecules at the surface of a metal held at high temperature. Copper foil, leading to high areas of monolayer graphene, is widely used for that.

The research conducted in the Université of Namur covers all these fields, including synthesis and characterization (diffraction, spectroscopy, microscopy) of samples produced by the techniques mentioned above. Chemical doping of graphene grown on SiC has been achieved by plasma treatment. Functionalization of graphene is conducted with the aim of endowing it with specific reactivity. In parallel to these experimental efforts, electronic and vibrational properties of graphene are searched out on the computer to learn how they are influenced by mechanical strain or by a particular lattice defect, edge, grain boundary, impurity or adsorbed molecule, and could thereby be tailored for specific applications. Plasmons and electromagnetic properties of graphene nanostructures are also under investigation in the quest for new optical and shielding effects.

Representative References

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- Vietnam international education development

Partnership

- NANOWAL (Réseau Wallon pour les nanotechnologies) http://www.nano.be
- FNRS Contact Group "Nanostructure" http://www.fnrs.be/fr/financer-les-chercheurs/groupes-de-contact.html
- French CNRS GDRi "Graphene and nanotubes" http://www.graphene-nanotubes.org
- European FP7 MC IRSES project 318617 FAEMCAR (2012-2016) http://www.faemcar.be

Main Equipment

- CVD reactors
- Chambers for plasma treatment
- Auger electron spectroscopy (AES)
- X-ray photoemission spectroscopy (XPS)
- Scanning transmission electron microscope (STEM)
- Scanning tunneling microscope (STM) and Atomic force microscope (AFM)
- PTCI computing center (Plateforme technologique de calcul intensif)

Products and Services

- Good knowledge of the field and of the literature
- Synthesis - doping - functionalization - characterization tools
- Modeling means for the interpretation of measurements

Keywords

Carbon
Chemical vapour deposition
Mechanical properties
Raman spectroscopy
Electronic properties
Plasmons
Nanotechnology

Contact(s)

Philippe LAMBIN
philippe.lambin@unamur.be
Tel. 32 (0) 81724721

Jean-François COLOMER
Jean-francois.colomer@unamur.be
Tel. 32 (0) 81724708

Web site(s)

http://www.pmr-namur.be