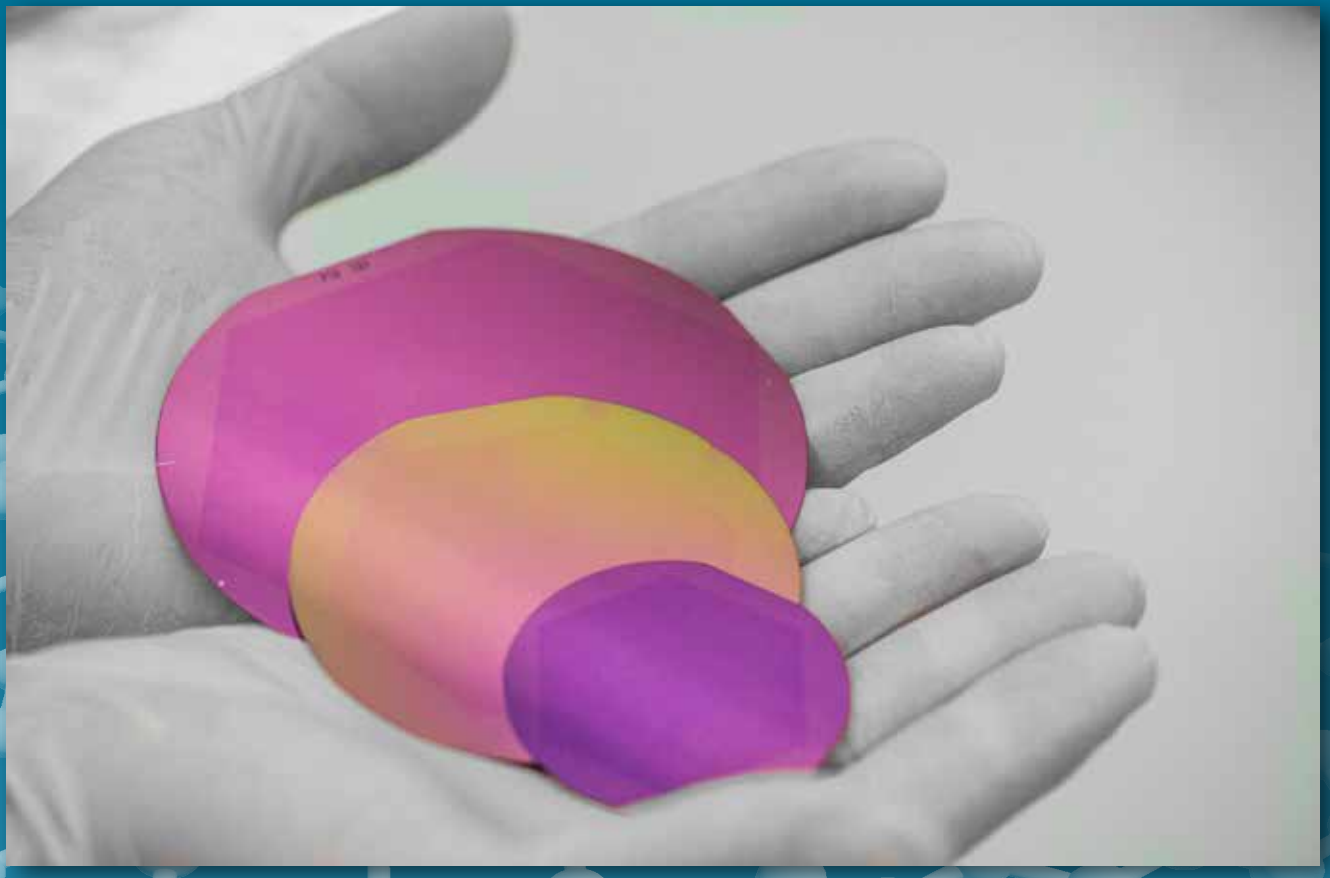
GRAPHEAT Solutions



Graphene on insulators

for next generation electronics

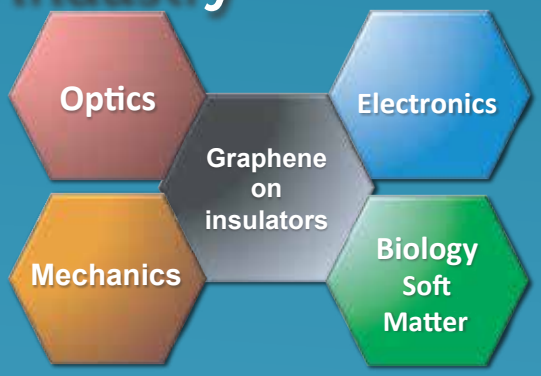
The substitute of ITO for emerging IoT

cnrs dépasser les frontières

NÉEL institut

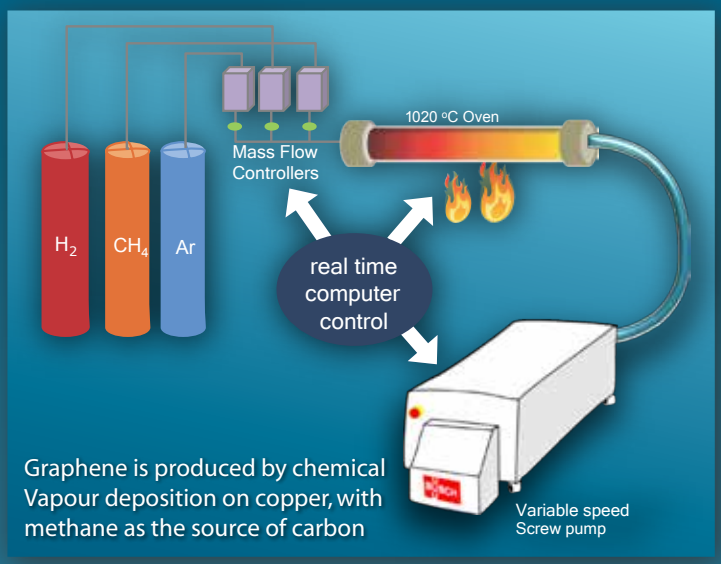
Graphene : from basic science to industry

Graphene is a ultimately thin (one atom thick !) pure carbon material with a in-plane structure similar to graphite. Unlike graphite its combines exceptional electronic, thermal, optical and mechanical properties. First isolated in 2004 by K. Novoselov and A. Geim at the University of Manchester. They received the Nobel Prize of Physics in 2010 for their discovery. Graphene has shown tremendous progress in its production during the last 10 years.
It can be now routinely produced at large scale.
In 2013, European Union has designated graphene as a key material for more energy efficient and less polluting tommorow's technologies.

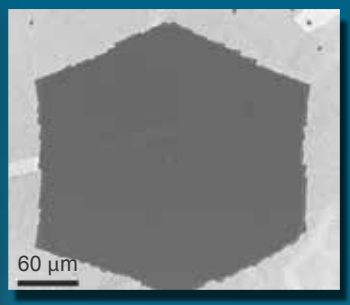


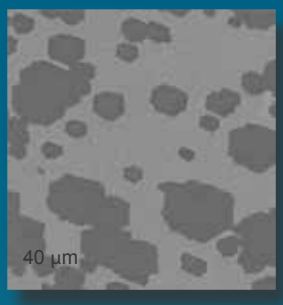
With numerous applications, Graphene on insulator is a the crossroads of a new class of devices bringing together the combined properties of graphene.

1. Catalytic CVD growth of Graphene



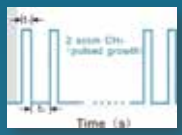
Graphene is produced by chemical Vapour deposition on copper, with methane as the source of carbon

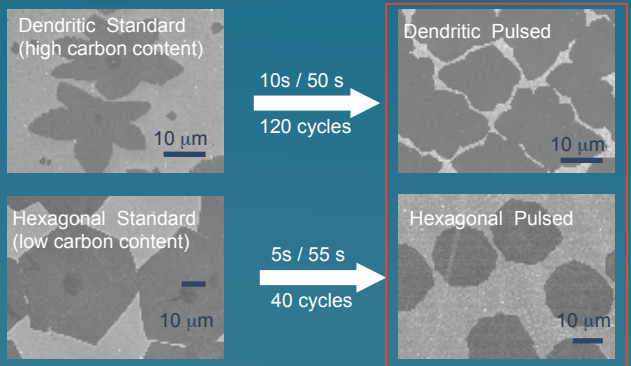




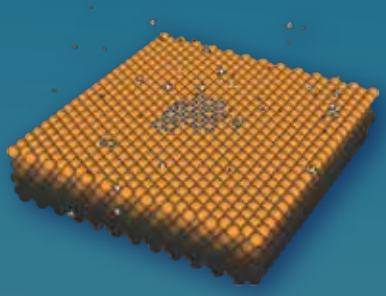
Large single crystal graphene grains expands on Cu surface. Coalescence of grains leads to continuous monolayered film.

Pulsed growth leads to complete suppression of multilayers



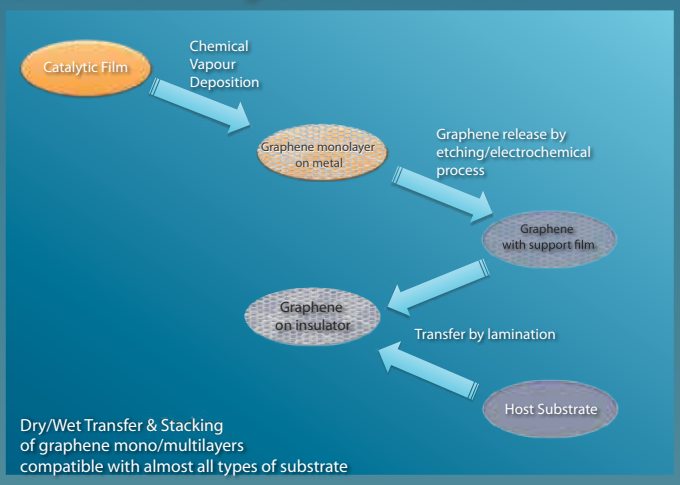


US Patent pending, published : Z. Han et al. , Adv. Func. Mat. vol. 24. p.964 (2014).



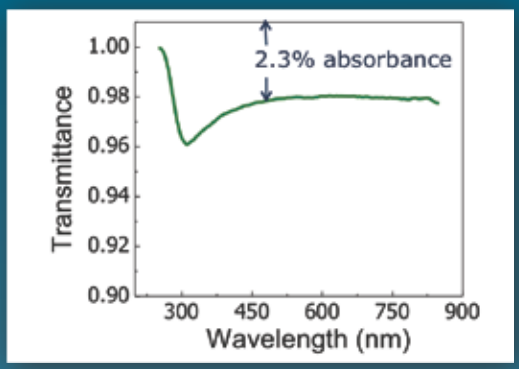
Catalytic effect leads to surfacic growth. Due to insolubility of carbon in copper, no carbon penetrates the bulk, leading to pure 2D growth.

2. Process Flow : growth and transfer



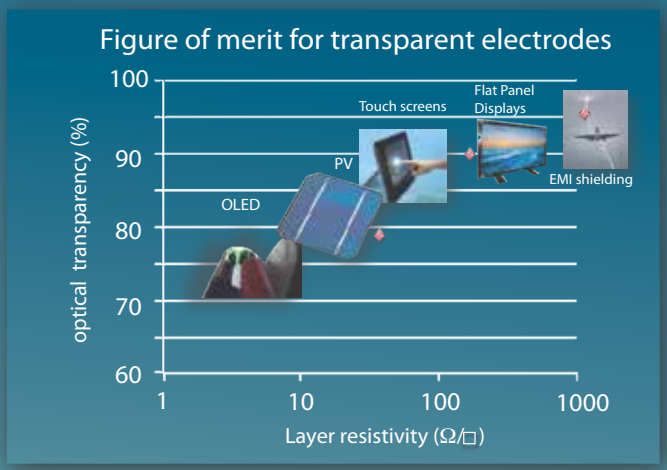
Application to Optoelectronics Devices

Graphene is a material which slightly absorbs visible light but provides at the same time excellent surface conductivity. With a suitable dopant, its conductance/absorbance ratio matches or exceeds state-of-the-art materials for transparent electrodes.



Graphene uniformly absorbs 2.3 % of light

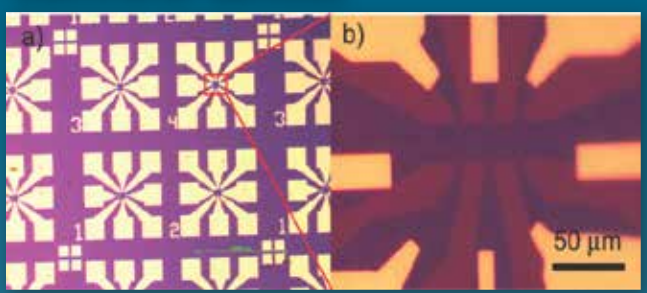
Electrically conducting graphene-covered Joule Heated glass window



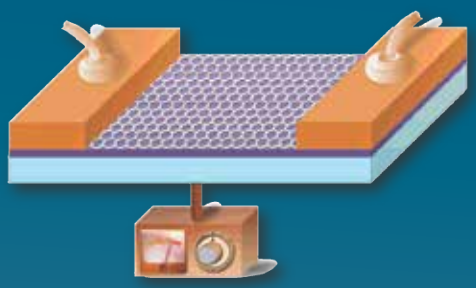
Crédits : D.Kalita and INAC, CEA-Grenoble

GaN LED with graphene top electrode

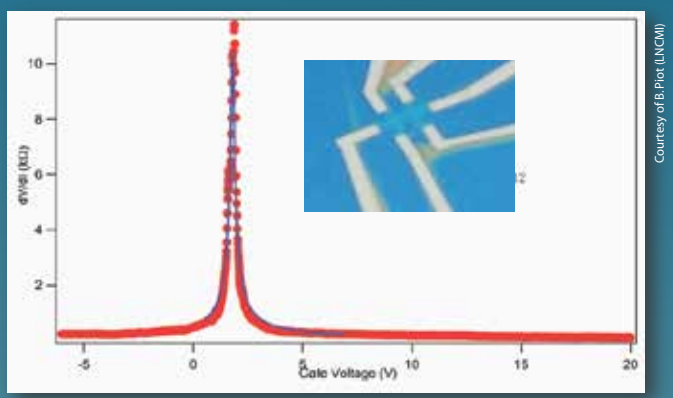
Electronic devices



Graphene on insulator can be processed with standard RIE plasma etching / deposition steps leading to integrated devices.

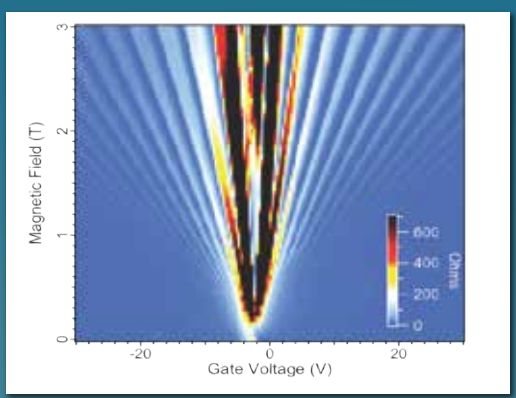


Schematics of a graphene transistor.
The channel is here exposed to the environment while the gate voltage is applied to the substrate (backgate).



Courtesy of B. Plaçais (LNCMI)

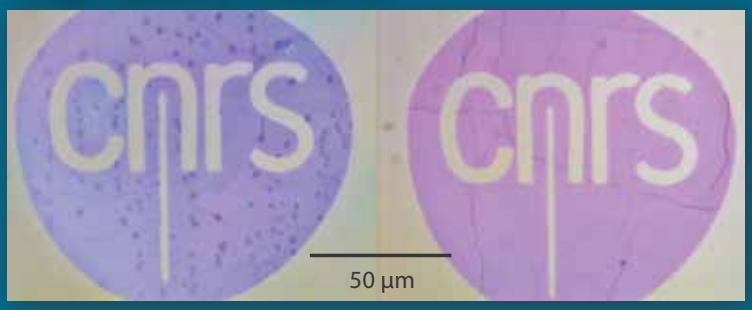
Field Effect of Grapheat-Solution transistor measured at low temperature (4K) . Grapheat-Solutions devices show an electronic mobility reaching 120,000 $cm^2.V^{-1}.s^{-1}$



Crédits : Z.Han & Columbia U.

Under magnetic Field, graphene transistors exhibits quantized transverse conductance due to quantum Hall effect. This effect can be used for resistance standard.

High quality material

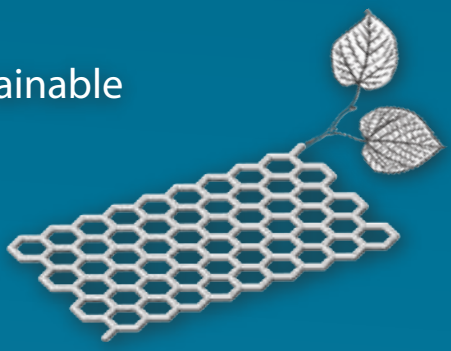


- Electronic mobility above 5000 $cm^2/V/s$ at 300K
- proprietary pulsed CVD gives monolayers w/o patches

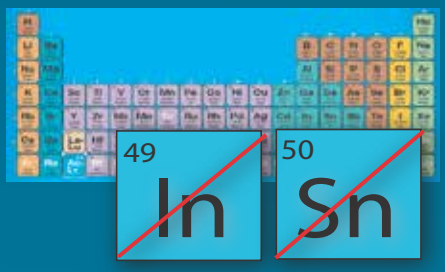
Highly bendable & flexible

- Exceptionnal mechanical resistance
- Suitable for flexible, non-flat displays

Sustainable

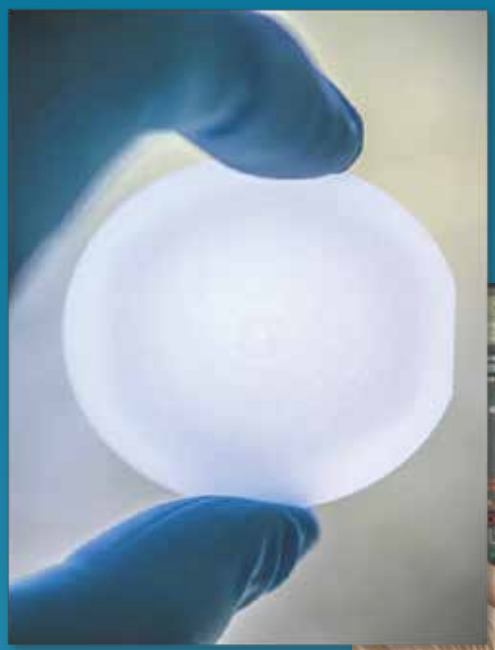


- Pure carbon technology



- Metal-free replacement of ITO for transparent electrodes

Graphene on 2",3",4" silicon wafers



Graphene on sapphire

Graphene on thin polymer films

Grapheat Solutions is a spin-off from Néel Institute, a condensed matter physics lab at CNRS Grenoble , supported by SATT Gate1 and by Institute of Physics of CNRS. Scientific and technical Expertise is provided by researchers with 15+ years of experience in carbon nanotechnologies.

More info available at : www.grapheat-solutions.com

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