

## 4. Applications with organic, inorganic and hybrid materials

4.7 Graphene

A. K. Gein: 2002 how thin I can do a grafite film?

2004 Published

2010 Nobel prize in Physics



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# 4. Applications with organic, inorganic and hybrid materials

### 4.7 Graphene

#### New structures with Carbon







fullerene

nanotube

graphene



### Graphene oxide





4.7 Graphene



Properties:

**Electrical**: Charge density up to  $10^{13}$  cm<sup>-2</sup>, with a mobility of  $1 \cdot 10^4$  cm<sup>2</sup> V<sup>-1</sup> s<sup>-1</sup>. At low temperatures, it may increase to  $2 \cdot 10^5$  cm<sup>2</sup> V<sup>-1</sup> s<sup>-1</sup>.

**Optical**: highly transparent material, each layer in thickness absorbs up to 2.3% of white light, with less than 0.1% reflectance.

**Thermal:** thermal conductivity of 3000-5000 W m<sup>-1</sup> K<sup>-1</sup> at room temperature. It drops to 600 W m<sup>-1</sup> K<sup>-1</sup> when attached to another substrate. Still Twice Thermal conductivity of Cu

**Mechanical:** one of the strongest materials ever made. A single-layer graphene sheet can withstand up to 42 N m<sup>-1</sup> of stress, with a Young's modulus of 1.0 TPa.

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### **Aplications:**

#### Medicine:

Tisues: provides improved mechanical properties (resistance). improvess adherence to surface Sensors: Easy functionalization + conductivity Drug delivery: change in shape

#### **Electronics**:

Transistors Nanowires Buffer layers

**Optics:** Photodetector (IR)

Energy : Storage (supercaps) solar cells: Improve contacts

https://www.cheaptubes.com/graphene-synthesis-properties-and-applications/ http://www.newyorker.com/magazine/2014/12/22/material-question



