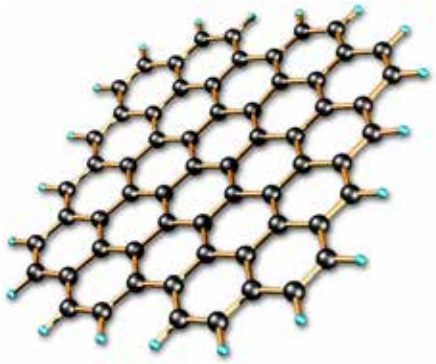
Graphene: structure and properties of a unique 2D material

Nunzio Motta

School of Chemistry Physics and Mechanical Engineering,
Queensland University of Technology – Brisbane 4001 - Australia

Graphene is just one single layer of graphite. Obtained by a humble and no-cost technique by using adhesive tape to peel off repeatedly layers of graphite in 2004[1], the isolation of this material is the reason of the Nobel Prize awarded to Geim and Novoselov in 2010[2].



Many of us had the experience of peeling off a layer of graphite to observe its clean surface under an STM microscope, or to do other interesting experiments. But no one had the idea to look at the material left on the scotch tape.
This is the difference between an ordinary scientist and a Nobel Prize.

Graphene is much more than just a flat crystal.
In this lecture I will try to explain the reason for which this material is so appealing.
It possesses a number of unusual properties, which are often unique or superior to those in other materials. Its electrons behave like massless relativistic particles in 2 dimensions. The toughest material in the world, it can be easily attached to surfaces, but it is difficult to break. Its electronic properties are remarkable, but the controlled growth of graphene layers on surfaces is still a challenge. Scientists all around the world are working at making it the Silicon of the 21st century. I will review a few potential applications in electronics and as a sensor material, as well as briefly outline the band theory of graphene, which has been developed in 1947 by Wallace[3] as a step towards the theory of graphite.

1. Novoselov, K.S., et al., *Electric Field Effect in Atomically Thin Carbon Films.* Science, 2004. **306**(5696): p. 666-669.
2. Novoselov, K.S., *Nobel Lecture: Graphene: Materials in the Flatland.* Reviews of Modern Physics, 2011. **83**(3): p. 837.
3. Wallace, P.R., *The Band Theory of Graphite.* Physical Review, 1947. **71**(9): p. 622.