Graphene: Wonder material?

Graphene

a single atomic layer of graphite, which is a form of carbon

Properties

Strong—200x stronger than steel
Hard—harder than diamond
Flexible—as flexible as rubber
Thin & lightweight
Almost transparent
Catalyst
susceptible to oxidative environments

Can be hydrophobic or hydrophilic
Impermeable
Conducts heat
Conducts electricity
No band gap
Never stops conducting—electronic applications are limited

Competitors

Will graphene be outdone by another 2D material?

silicene, germanene, phosphorene (have a small band gap)
stanene (tin)

Research

Focused on benefits of graphene
Limited funds for health and environmental impacts research

Creation

Natural—from graphite
Synthetic—e.g. from honey
2 main methods:
Exfoliation
Growth on surfaces
Some toxic prep methods
energy intensive methods

Research **proves** graphene is toxic to humans
studies suggest may cause **cancer** like asbestos

Applications

Where do development dollars go—applications such as ultrafiltration of water for the developing world or Western luxury items?

Current

Paints and inks
Sports equipment
Touchscreens

Potential

Ultrafiltration
Energy storage
Electric cars
Wearable technology
Optical electronics
Semiconductors
Biological engineering
Anti-cancer medication
Potential for harmful deposits in the body

Will the benefits outweigh the costs?

?

uncertain future

Sustainability

Recyclable
Biodegradable
Non-renewable resource
Feasability of recycling
Particles very mobile in water—environmental damage

Supply

Demand could exceed supply
Price volatility
China dominates 70% of market
Currently unable to produce commercially viable quantities

Could all be a waste of billions of dollars

Magic
↳ Alchemy
↳ Enlightenment+science

History

1947 possibility of graphene first posed by Canadian physicist Philip Wallace while studying graphite

2004 academics from the University of Manchester, Andre Geim and Kostya Novoselov, isolated graphene for the first time from a lump of graphite by using sticky tape

2004 onwards global explosion into the study of graphene and its potential uses

"The potential of graphene is limited only by imagination!"
Who does this benefit?

Redirective futures

Shift in material thinking—our material cultures

Do we need new materials or should we design better with the ones we already have?

Research cons thoroughly as well as pros

Study long-term effects

Manage risks
← unmanageable
← unsafe
← safe

Ban use

Apply to products in order of worthiness and usefulness

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Or the new asbestos?

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Discovery

late 1800s — Commercial use (during the Industrial Revolution)

"The wonder material!"

Research

Deadly consequences overlooked

Widespread Application

- Fireproofing
- Construction materials
- Cement
- Insulation
- Pipes
- Brake lining
- Appliances & toys

Consequences

Multitude of health problems, many deaths worldwide
Waste of resources including time and money

1970s onwards — Bans in much of the developed world, although alarmingly not in the US

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"Those who fail to learn from history are doomed to repeat it."