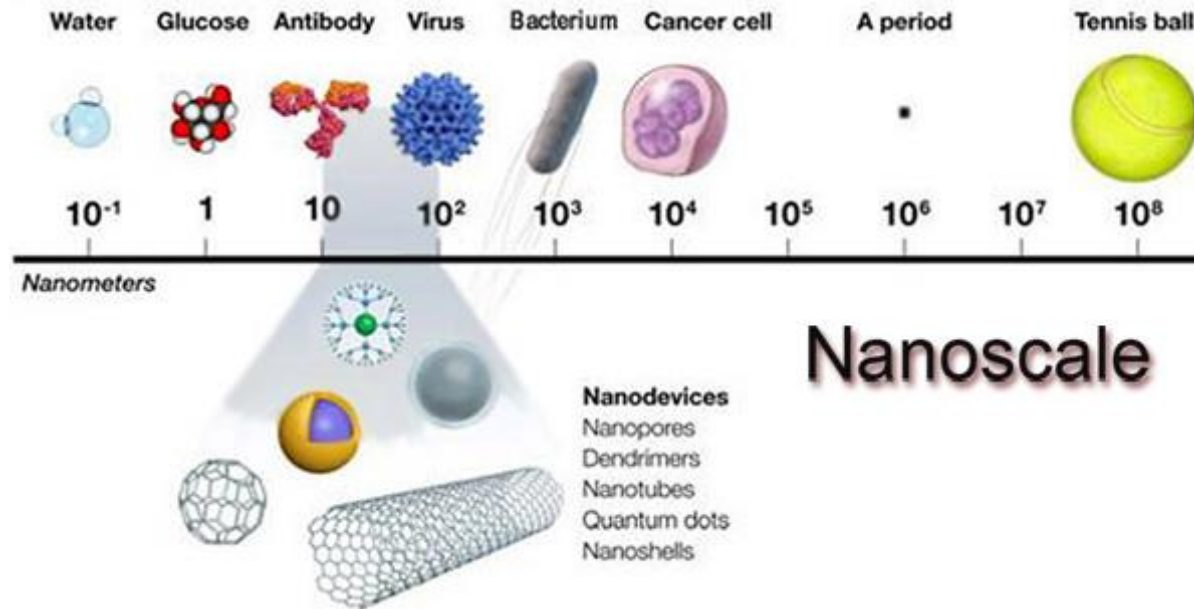


Application of Nanomaterials

Petr LOUDA

What is nanoscale?

- ▶ Dimensions in the range 1-100 nm, with nanomaterials being those that contain particles (or sometimes spaces or pores) in this range in at least one plane.



What is Nano?

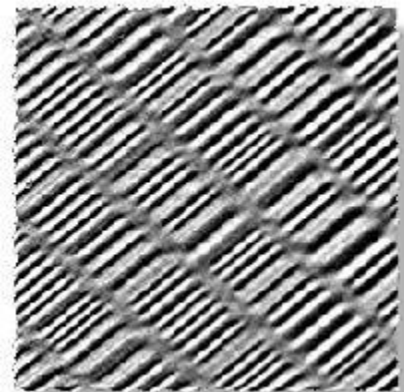
- Origin is from Greek *nannos*, *little old man, dwarf*
- Extremely Small, one-billionth

1 Nanometer = 10^{-9} meter

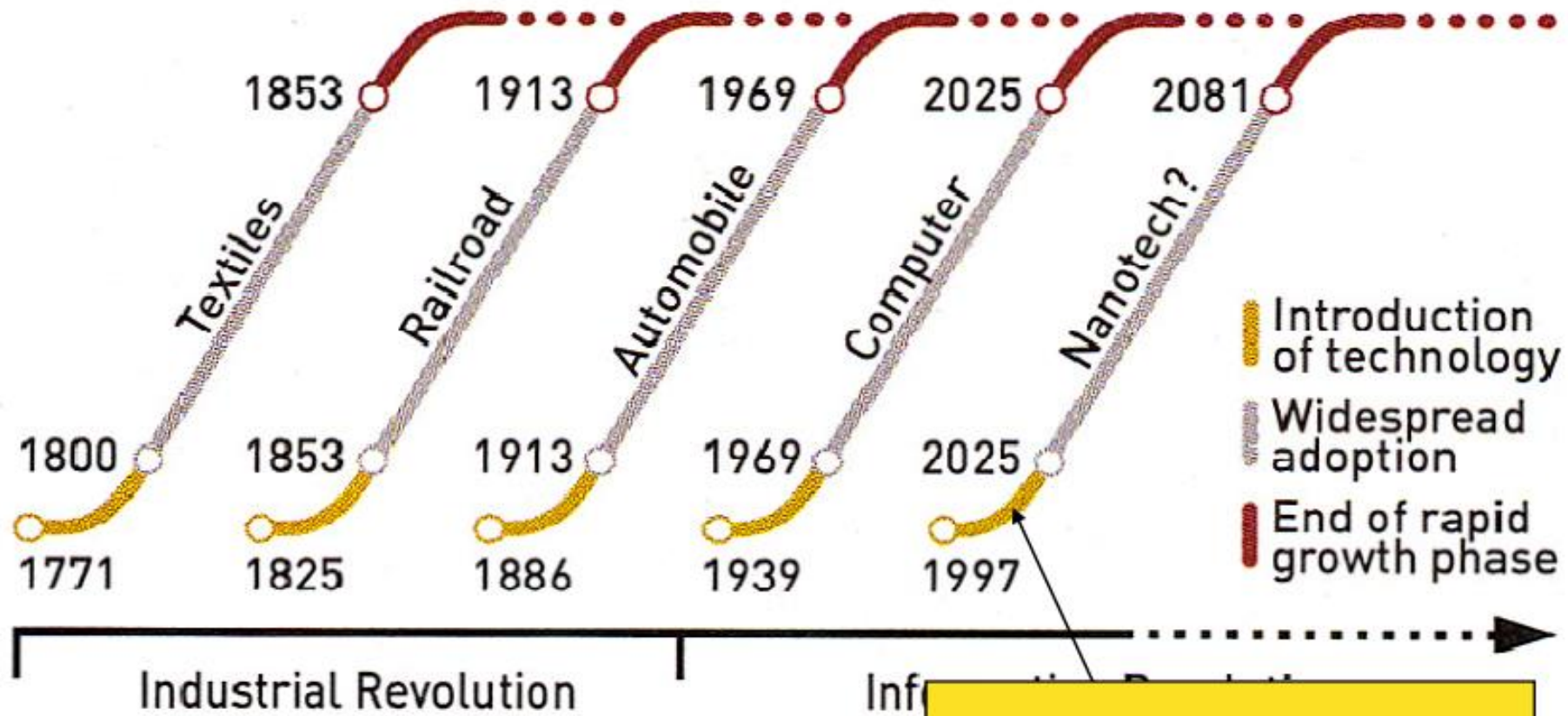


CHARACTERIZATION AND DETECTION TECHNIQUES

- ▶ Essential requirements for the development, manufacturing and commercialization of nanomaterials is their physical, chemical and biological properties on a nanoscale level
- ▶ For determination of atomic structure and chemical composition of solid or liquid nanomaterials – spectroscopic methods, X-ray and Neutron diffraction
- ▶ For determination of size and shape – Electron microscopies (SEM or TEM)



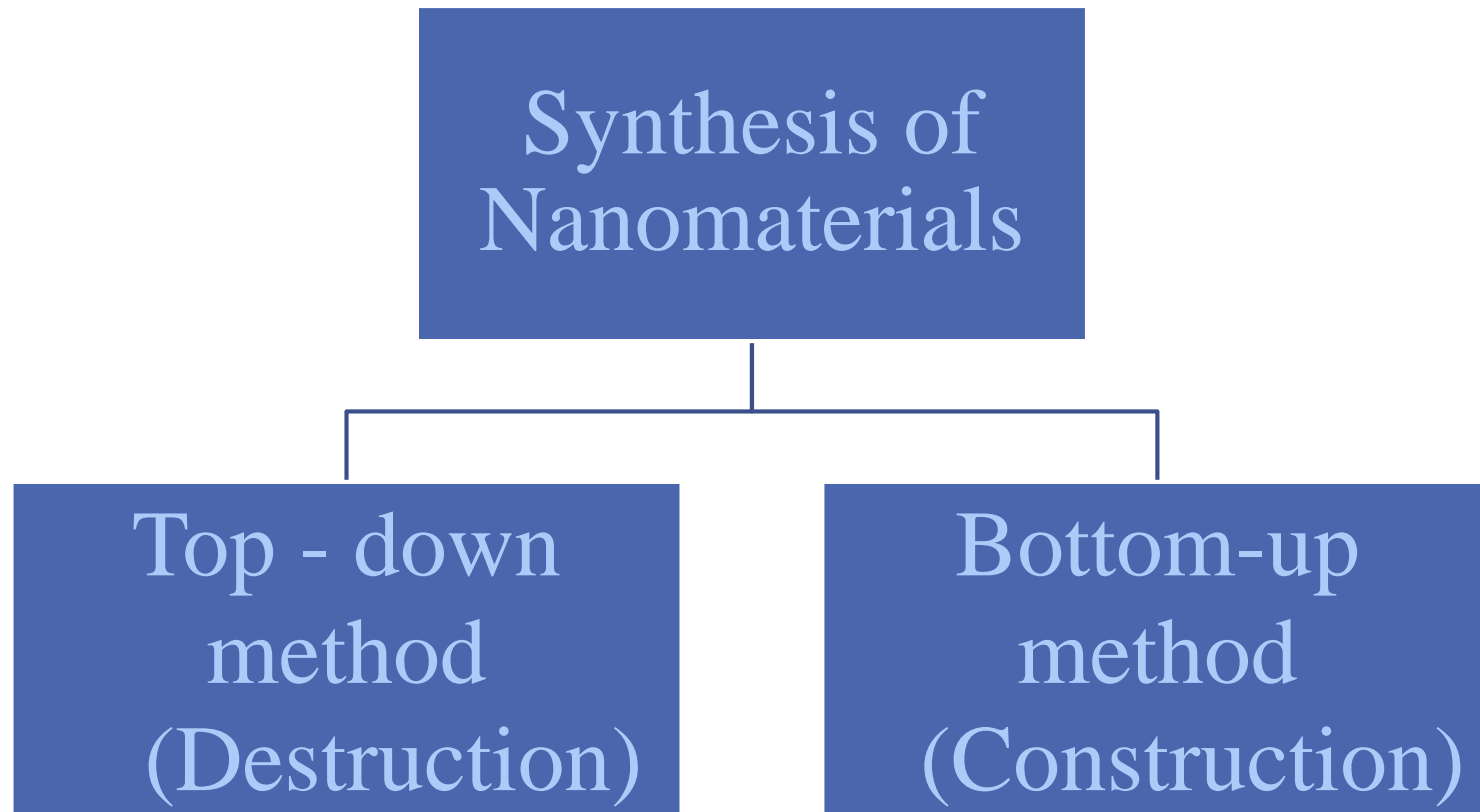
Basic advancements in science and technology come about twice a century and lead to massive wealth creation.

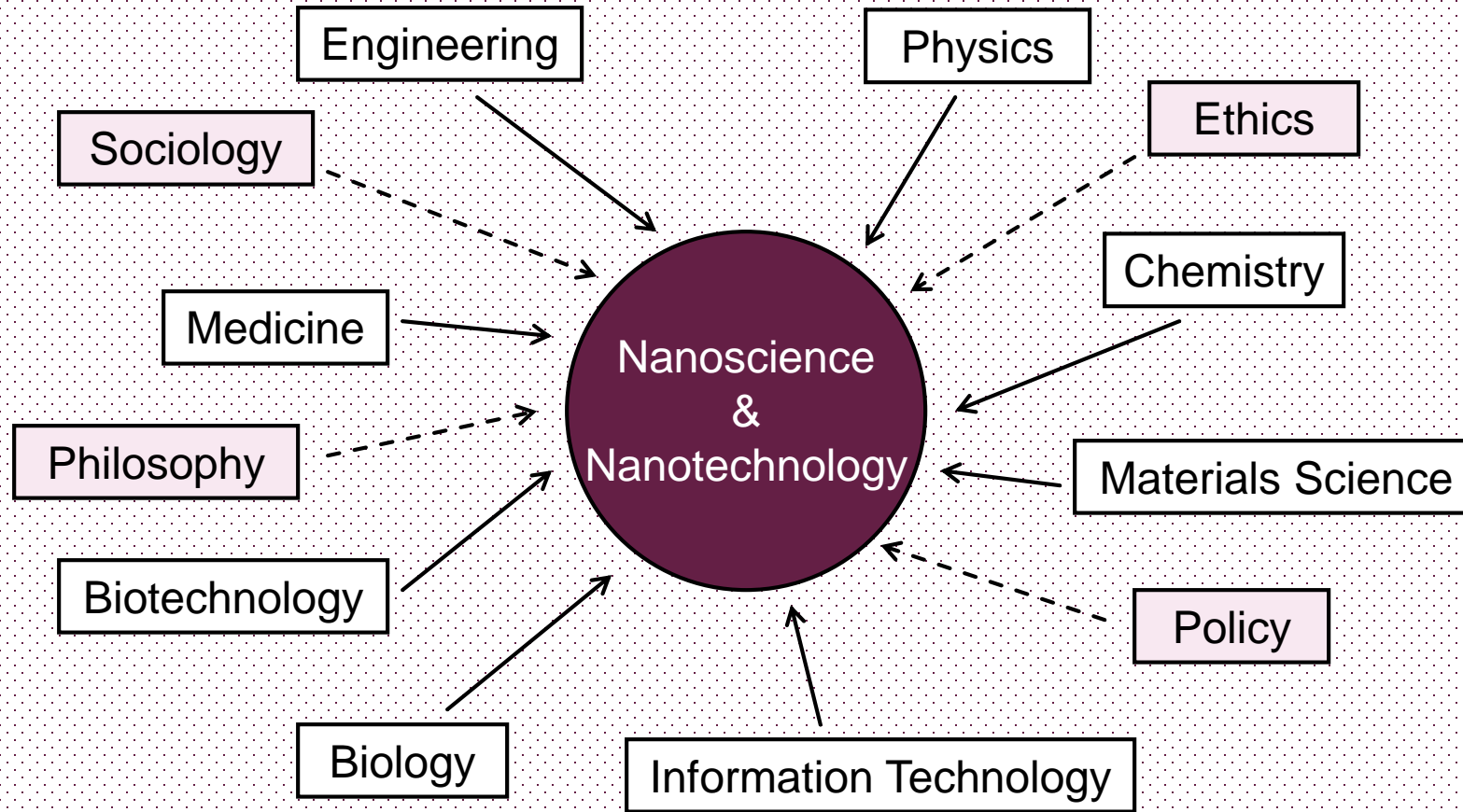


SOURCE: Norman Poire, Merrill Lynch

AQUI ESTAMOS!!!!
2019

Synthesis of Nanomaterials







- ▶ Titanium Dioxide
- ▶ Silica
- ▶ Silver
- ▶ Carbon Nanotubes
- ▶ Graphene



Titanium Dioxide



Anti-pollution



Anti-bacterial



Self-cleaning



Hydrophobic



Abu Dhabi Airport (United Arab Emirates)



Glasgow Science Centre (UK)



*Titanium application in stadium coatings
Oita Stadium Big Eye (Japan)*

Titanium Dioxide



Nanomaterials in Construction

Type	Nanomaterials commonly used
Coatings	Silica, titanium, silver
Glass	Metal oxides
Concrete	Silica, titanium
Steel	Nanostructured
Insulation	Silica aerogels
Composites	CNTs, nanoclays
Others (roofs, floors)	Titanium, aluminium



- Compressive and tensile strength
- Abrasion resistance



Silica



Water repellency



Abrasion resistance



Ultraviolet protection



High strength

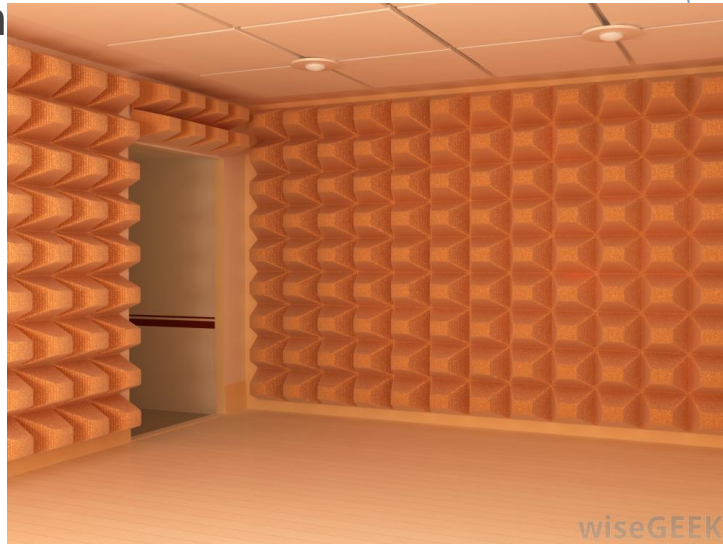


Self-compacting



Coatings

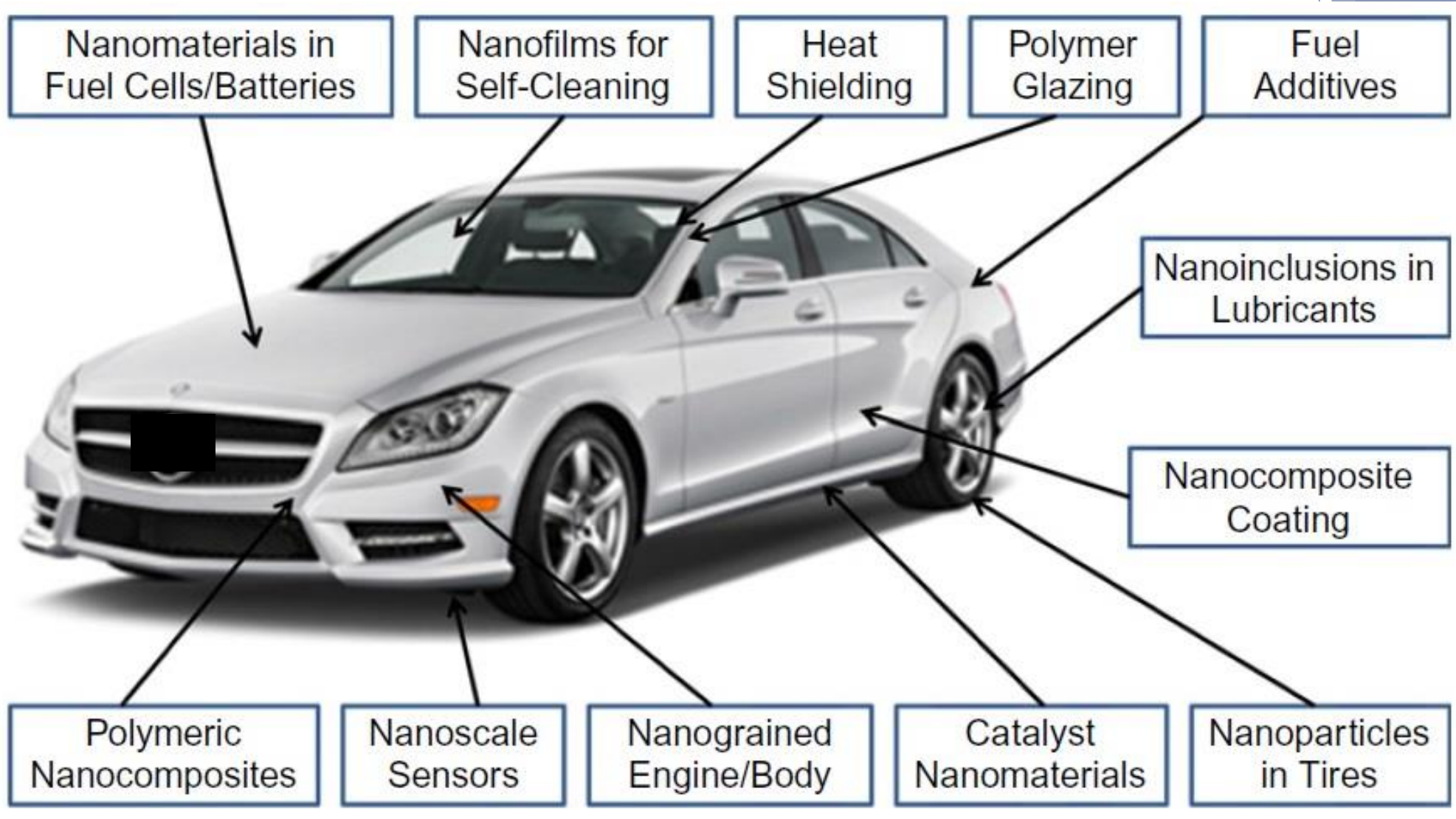
- ▶ Thermal insulation
- ▶ Fire insulation
- ▶ Impact insulation
- ▶ Accoustic insulation



Photovoltaics



Glass



Carbon Nanotube (CNT's)



Improve strength



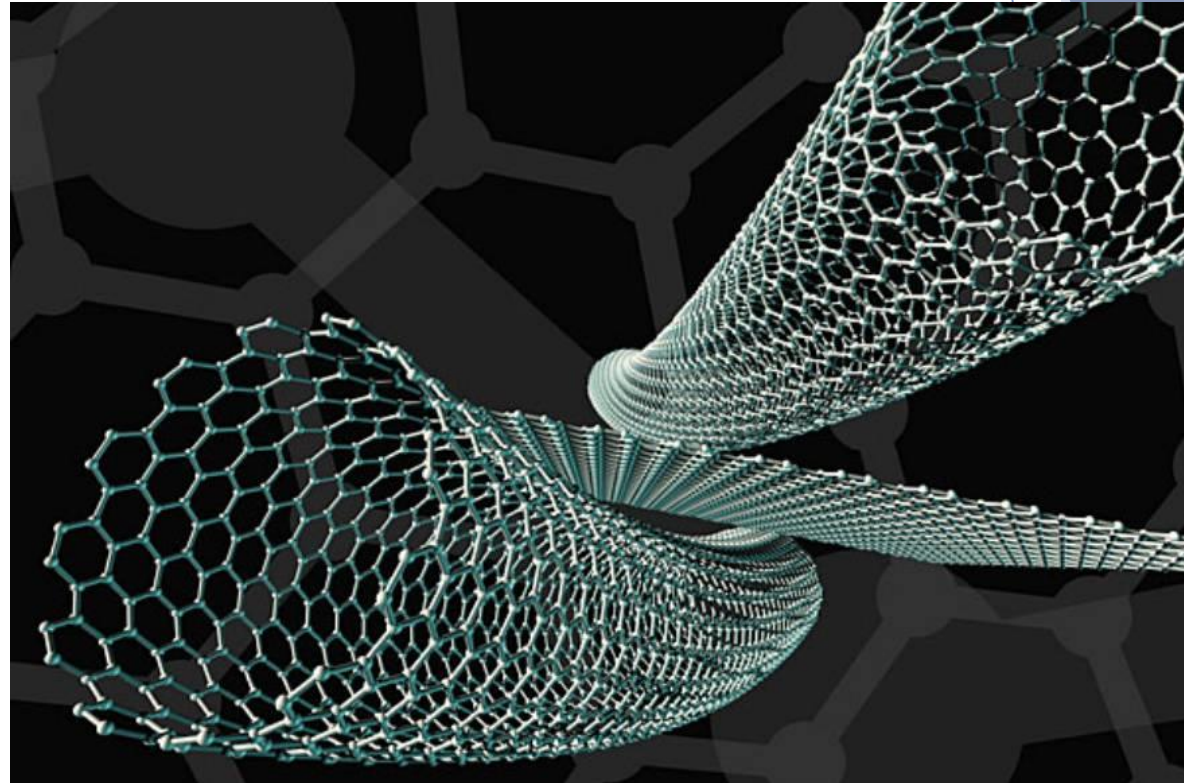
Electrical conductor



Fire Resistant

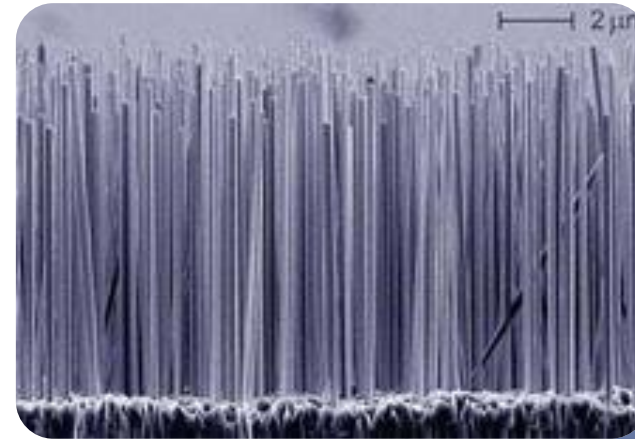


Anti-corrosion



„Chlupaté“ solární panely CNTs

- ▶ Univerzita v Santa Diegu (USA)
- ▶ Horní vrstva solárních článků pokryta nanodrátky o velikosti tisíce vlasu
- ▶ Lepší vodivost elektronů = vyšší účinnost



Graphene

Graphene is an allotrope (form) of carbon consisting of a single layer of carbon atoms arranged in a hexagonal lattice. It is the basic structural element of many other allotropes of carbon, such as graphite, diamond, charcoal, carbon nanotubes and fullerenes.



Corrosion resistant



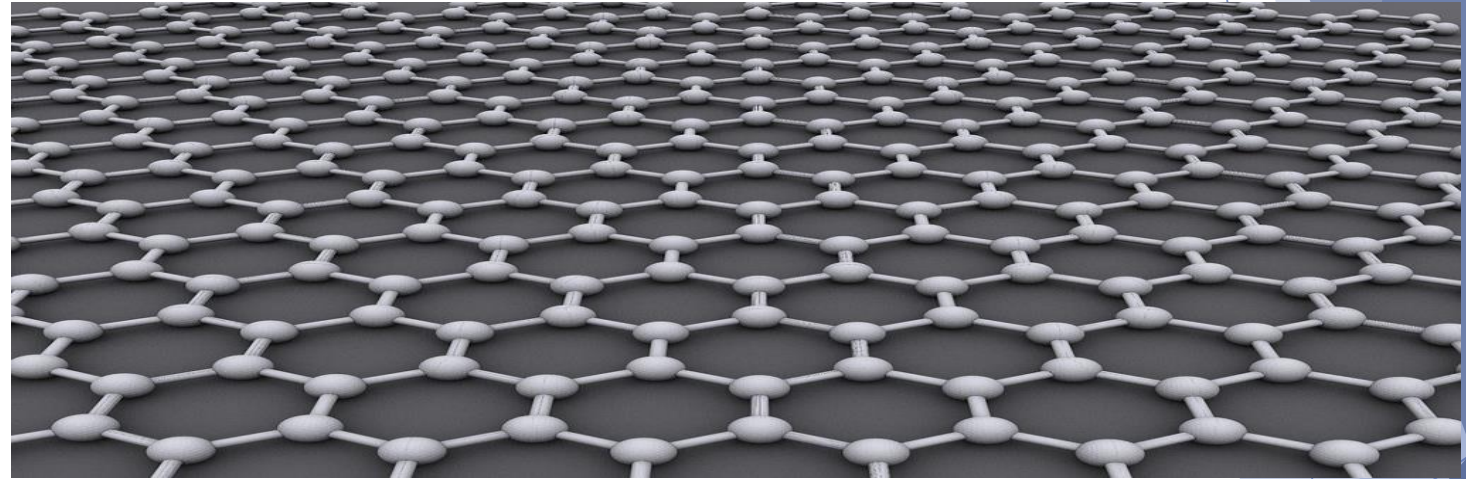
High strength



Electrical conductor



Friend of nature



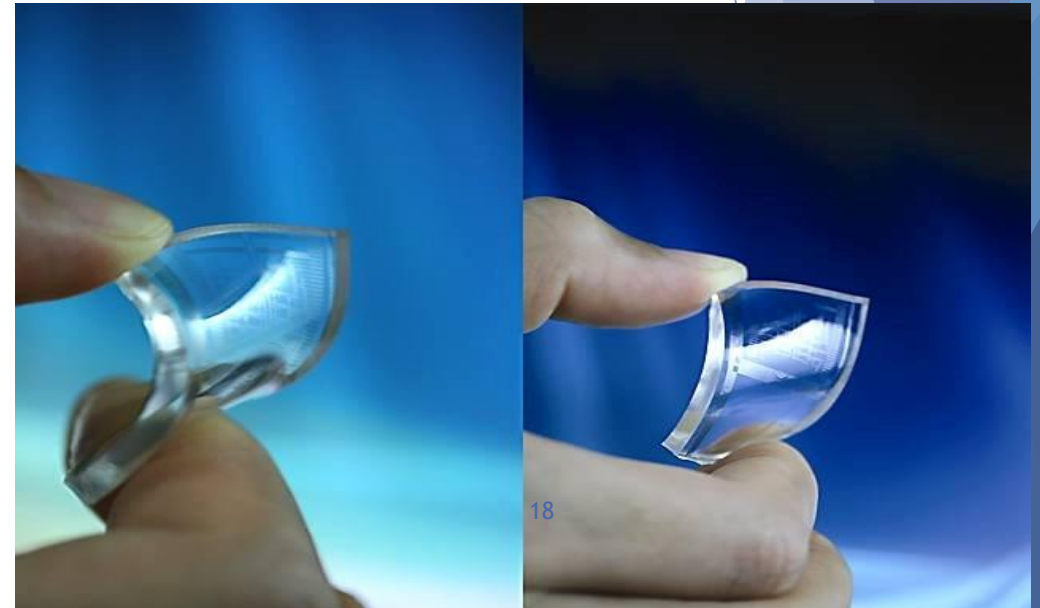
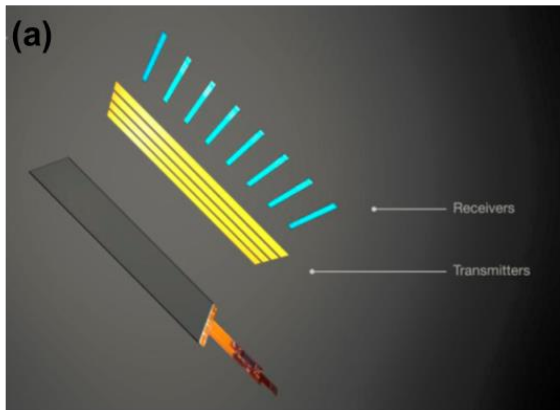
"Graphene has earned something of a reputation as a 'wonder material' with the potential to revolutionise our daily lives."

Specification

- **Very good conductivity of heat and electricity - measured thermal conductivity is 5000 W/m.K (silver - 429 W/m.K)**
- **It's tensile strength is 130 GPa, compared to about 0.4 GPa for steel**
- **It is 200 times stronger than steel, but it is incredibly flexible.**
- **It is the thinnest material possible as well as being transparent.**
- **It is a superb conductor and can act as a perfect barrier - not even helium can pass through it.**

Uses (potential)

- Transparency and excellent conductivity make graphene suitable for the production of transparent, roll-up touching displays (B,c) and for the production of renewable energy from solar batteries
- storage in high-performance batteries or insupercapacitors
- Sensors (a) from graphene can register the presence of a single molecule of harmful substances, finding applications eg in monitoring and environmental protection.

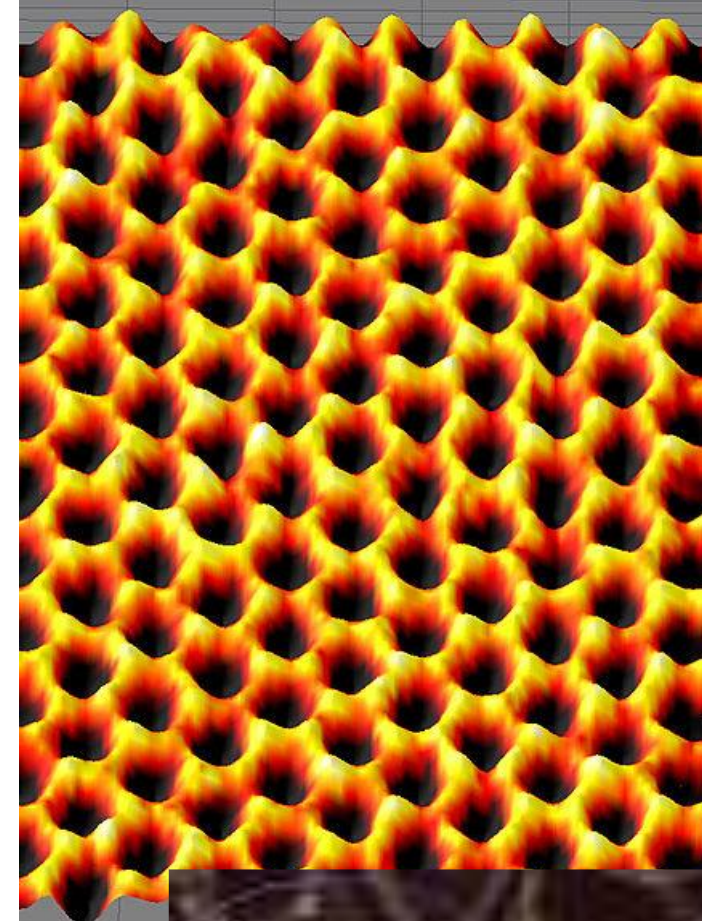
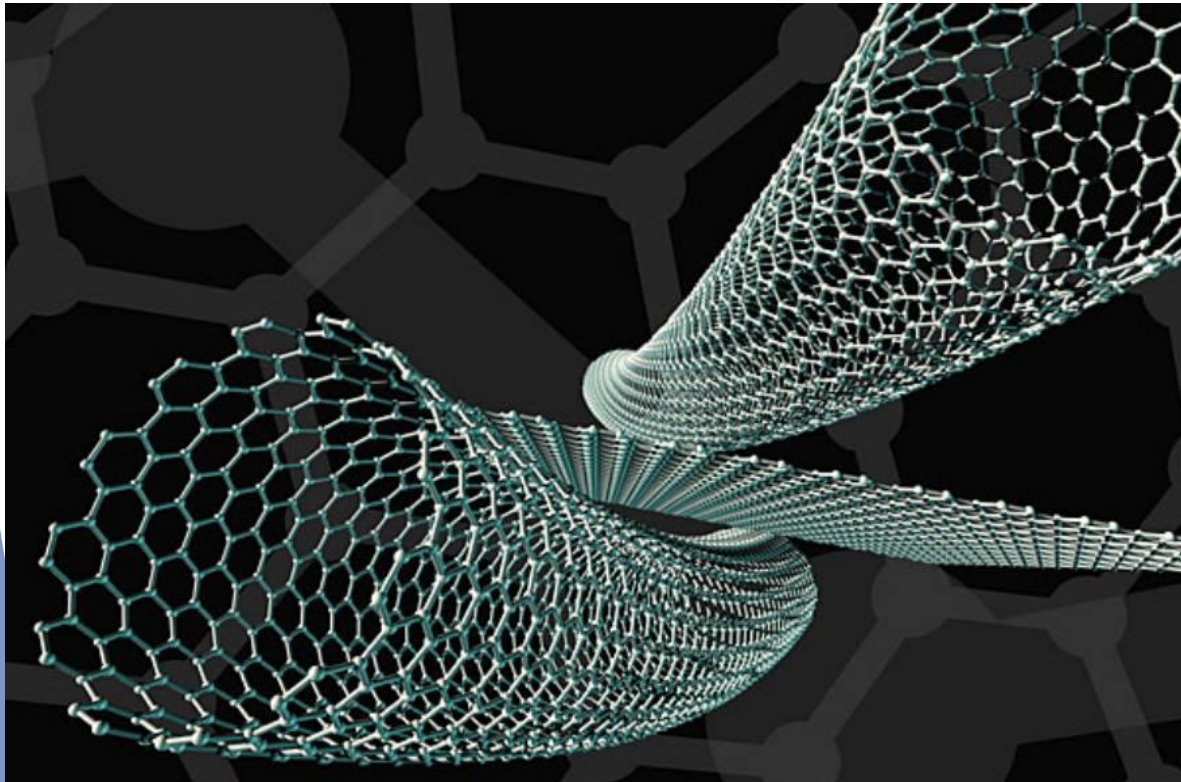


Užité vlastnosti materiálů

Na velikosti záleží

– atomární uspořádání vnitřní struktury

Čím menší tím lepší! 😊



$R_m = 100 \text{ GPa}$
 $1 \text{ m}^2 = 1 \text{ mg}$



Bionika

DĚKUJI ZA POZORNOST



kontakt: petr.louda@tul.cz

