



Future of non-metallic materials in industry (Automotive)

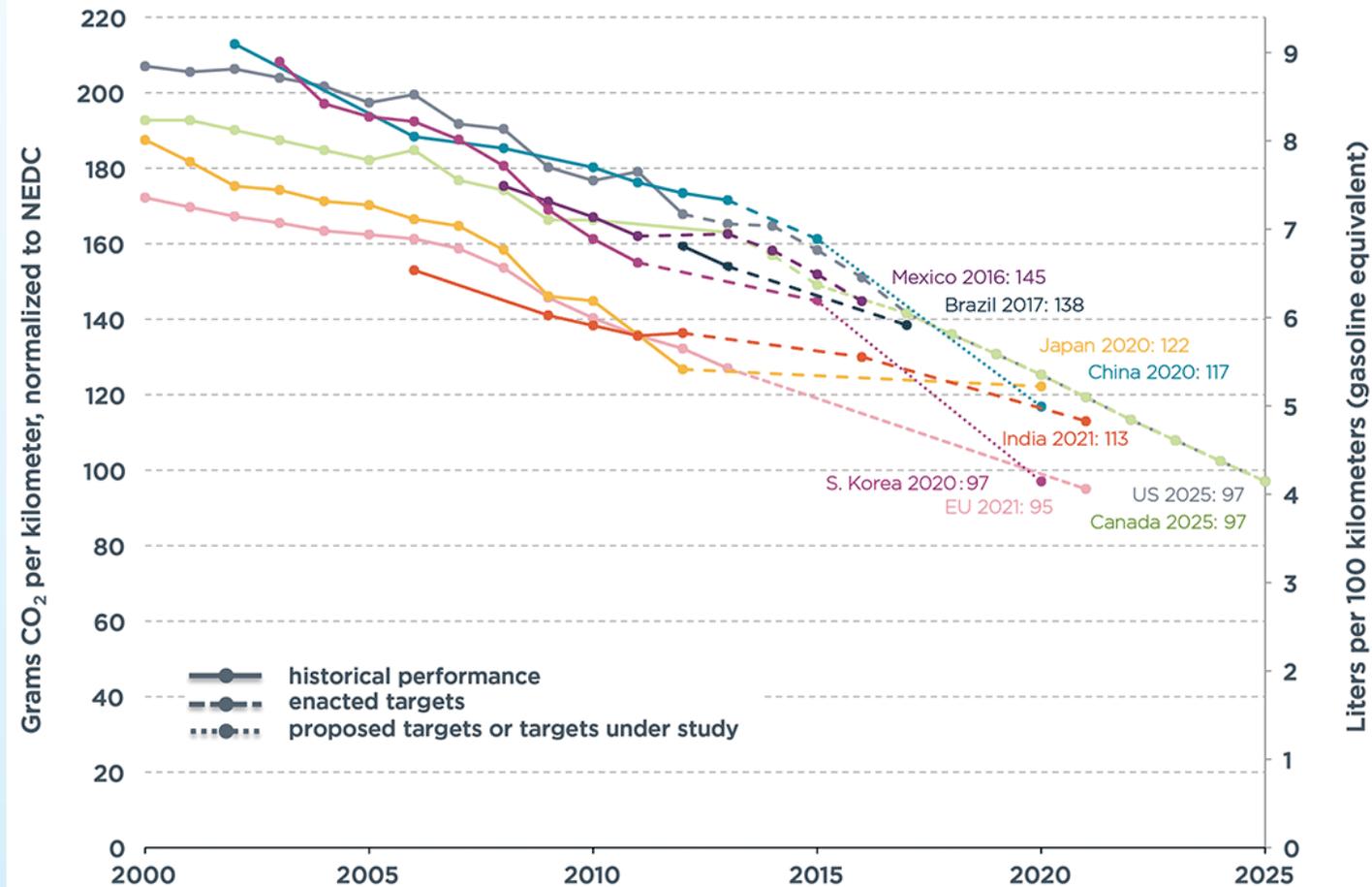
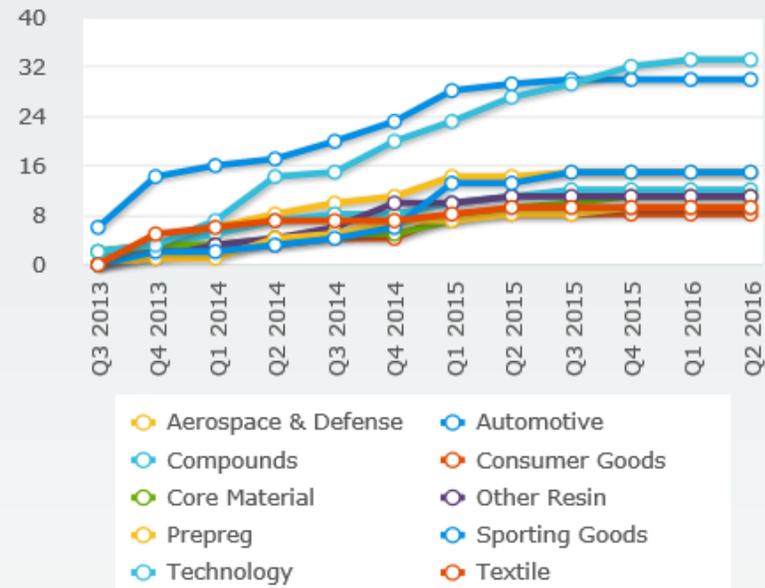
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Moderní výrobní technologie a materiály
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Content

- MS in the industry - automotive
- NF materials
- Properties/eco risk/€
- Nanomaterials
- Future ???

What's Trending in Composite Innovati...



Materials in the Automotive Industry

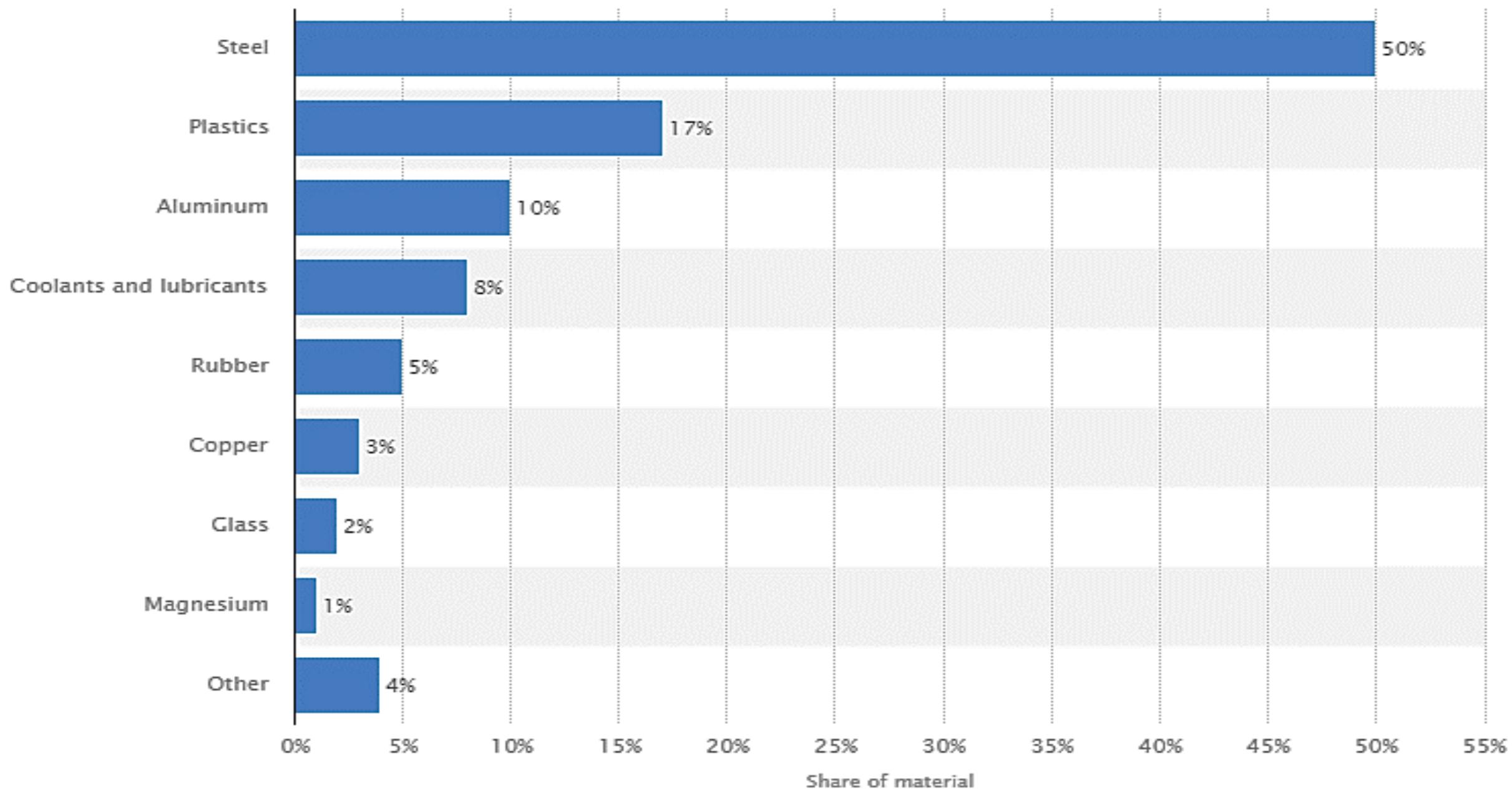
- ▶ According U.S. Department of Transportation it is estimated that more than **700 million passenger cars** are currently used **worldwide**
- ▶ **2016 92 million new cars** are produced in the world = huge opportunity for MS
- ▶ **MS** enhances and **improves the properties and performance** of materials and automobile technologies



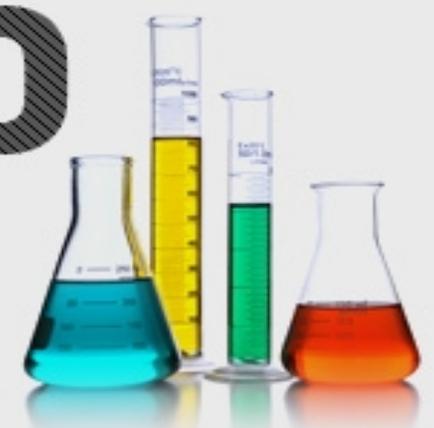


- Karl Benz generally is acknowledged as the inventor of the modern automobile.
- Benz automobile powered by his own four-stroke cycle gasoline engine was 1885.
- He began to sell his production vehicles in 1888





MATERIALS USED TO MAKE A CAR



Leather								<p>Polyester (PET)</p> $-\text{CH}_2-\text{C}-\text{O}-$
Cotton	Stainless steel	Fe Iron	Al Aluminium	Pd Palladium	O Oxygen	C Carbon		<p>Polyurethane (PU)</p> $\text{O}-\text{CH}_2-\text{O}-\text{C}-\text{NH}-\text{CH}_2-\text{C}-\text{O}$
Timber	Steel	Pb Lead	Cu Copper	Si Silicon	H Hydrogen	Xe Xenon		<p>Poly-carbonate (PC)</p> $\text{HO}-\text{C}(\text{CH}_3)_2-\text{HO}$
Natural Rubber	Quartz	Cr Chromium	Zn Zinc	Mn Manganese	N Nitrogen	Ne Neon		<p>Poly-propylene (PP)</p> $\text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H}$

Natural

Polymers

MATERIALS IN A CAR

Al

Radiator, intake manifold, cylinder heads, engine block, bumpers, wheels, body panels



Cotton

Car covers, car seat covers, seats



Natural Rubber

Tyres, wiper blades, engine mounts, seals, hoses and belts



Leather

Car seats, interiors



Steel

Car body



Stainless Steel

Car mufflers, decorative trims, exhaust silencers, catalytic converters



Xe

Light bulbs: headlights



Poly-ester

Seat covers, carpets



Poly-carbonate

Electrical insulator, decorative bezels, optical reflectors, laminated for bullet resistant windows



Poly-propylene

Bumpers, car batteries



Allianz

BROUGHT TO YOU
BY ALLIANZ AUSTRALIA

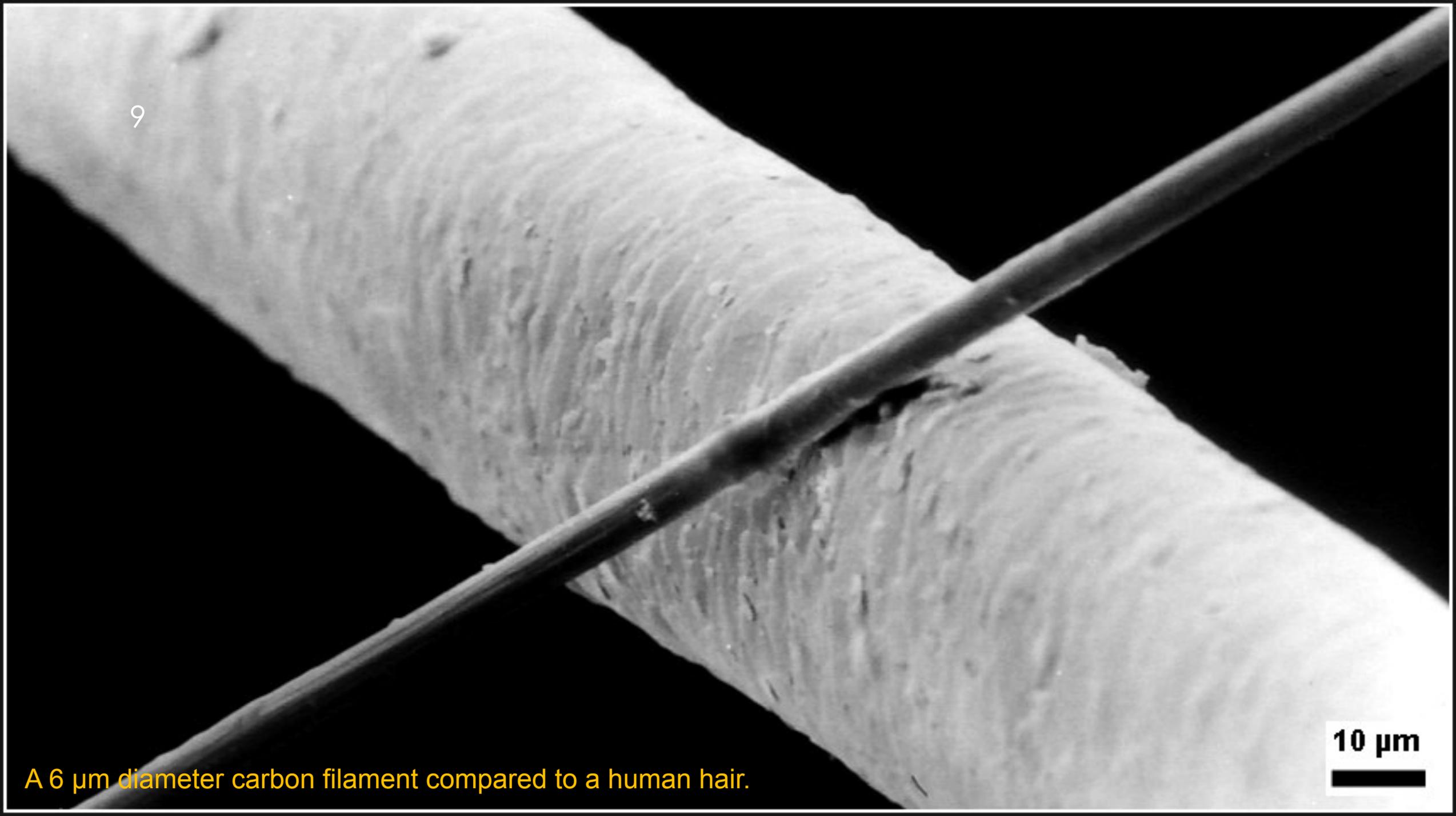
Carbon Fiber

- Composed of carbon atoms bonded together to form a long chain. The atomic structure of carbon fiber is similar to that of graphite.
- A super strong material that's also extremely lightweight.
- Carbon fiber is an expensive material. It can be very brittle if made poorly
- Five times stronger than steel , Two times stiffer , and about Two-Third times less in weight.

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10 μm

A 6 μm diameter carbon filament compared to a human hair.

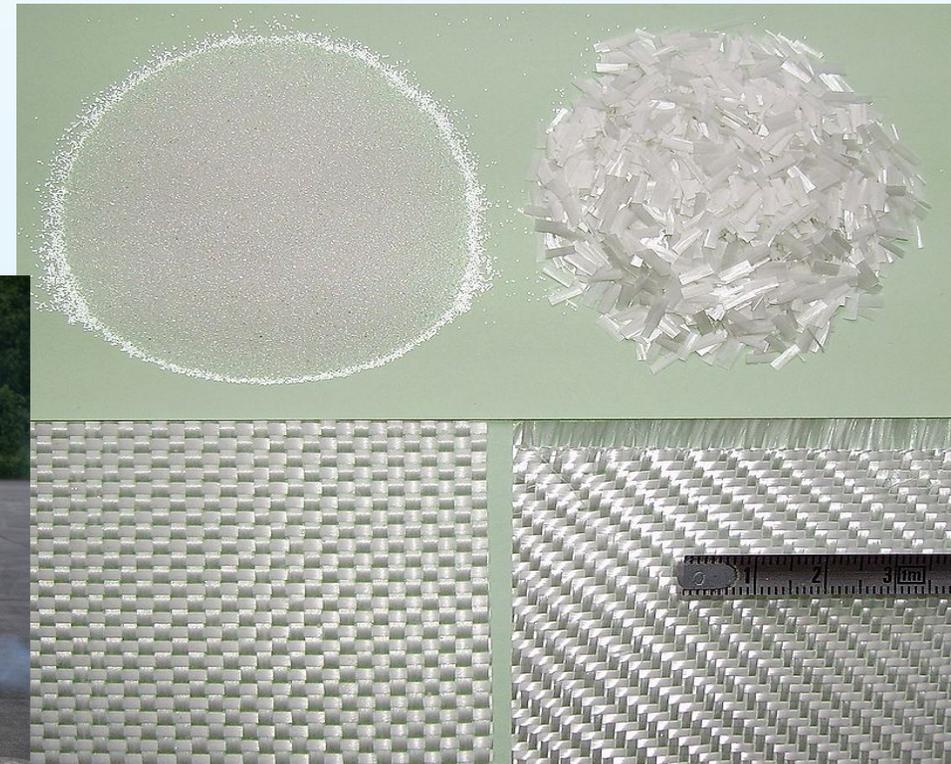


Property	Carbon Fibers		Carbon Nanotubes
	T300 PAN based	P120 Pitch Based	
Diameter (μm)	7	10	0.05
Density (g/cc)	1.76	2.17	~ 2.0
Elastic Modulus (GPa)	231	827	1000-1400
Ultimate Tensile Strength (GPa)	3.75	2.41	7-10
Thermal Conductivity (W/mK)	8	640	>2000
Coefficient of Thermal Expansion, CTE (ppm/K)	-0.6	-1.45	-1 (isotropic)
Electrical Resistivity (micro-ohm-m)	18	2.2	<0.1

Fiberglass

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- Fiberglass is a form of plastic reinforced with thin strands of glass.
- Commonly used for sports cars — the Chevrolet Corvette has had a fiberglass body for decades — the material's light weight and significant strength make it ideal for helping meet high fuel efficiency standards.



Coconut Husks



Coconut husks make pretty good seat cushioning

The fiber has very good strength, stiffness and ductility, and potentially can be used for all kinds of things

Car-door interior covers using fibers from the outer husks of coconuts

Mercedes already uses them in the S-Class

Bamboo

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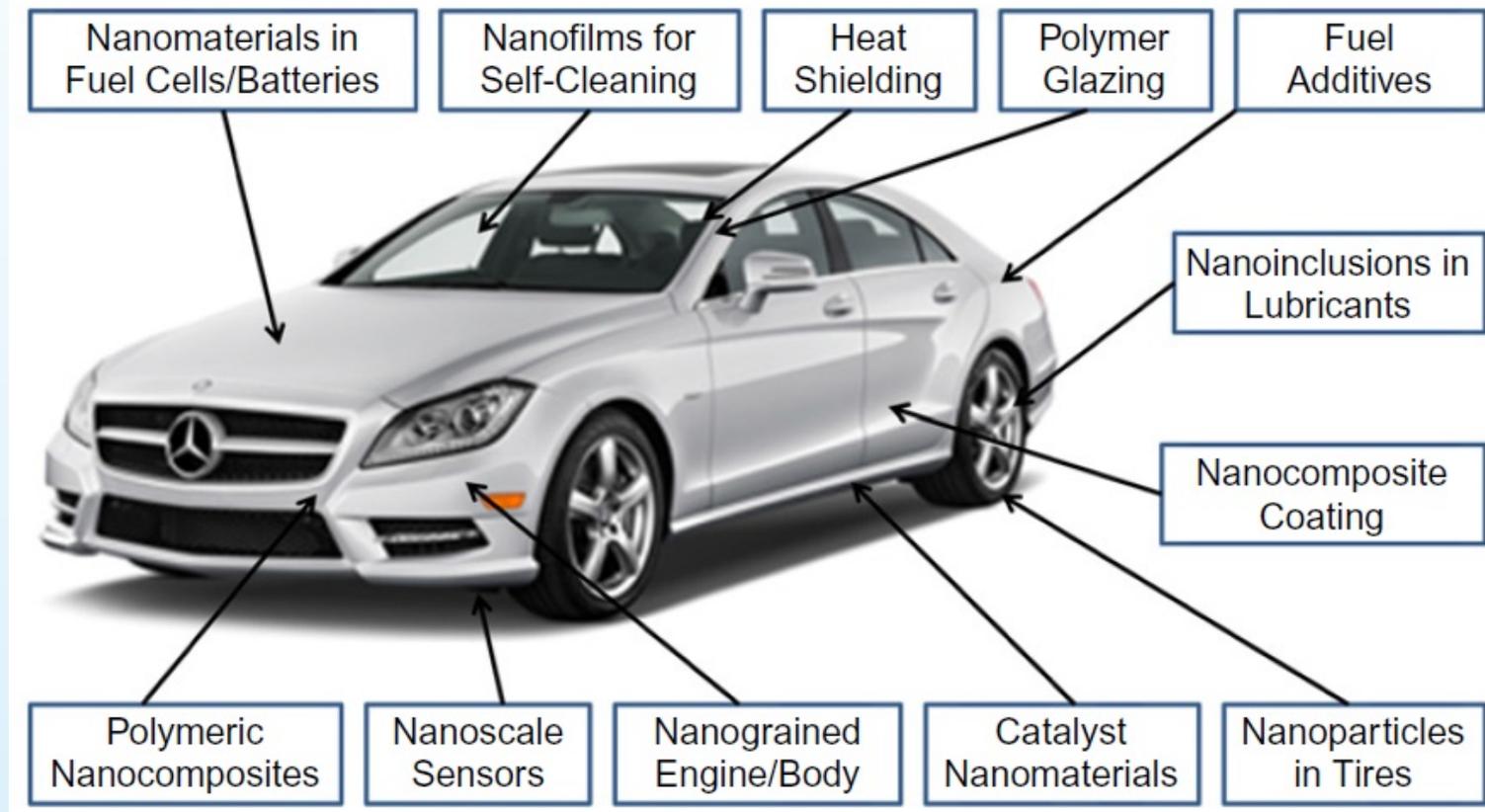
Bamboo is cheaper and more renewable than wood and is abundant

When combined with an epoxy coating, is exceptionally strong and lightweight

With the right approach, bamboo can be used in many applications in the automotive world where its performance qualities can be better than carbon fiber.

Is being used in the interior of some vehicles, like the BMW i3

Applications of nanotechnology in the automobile industry

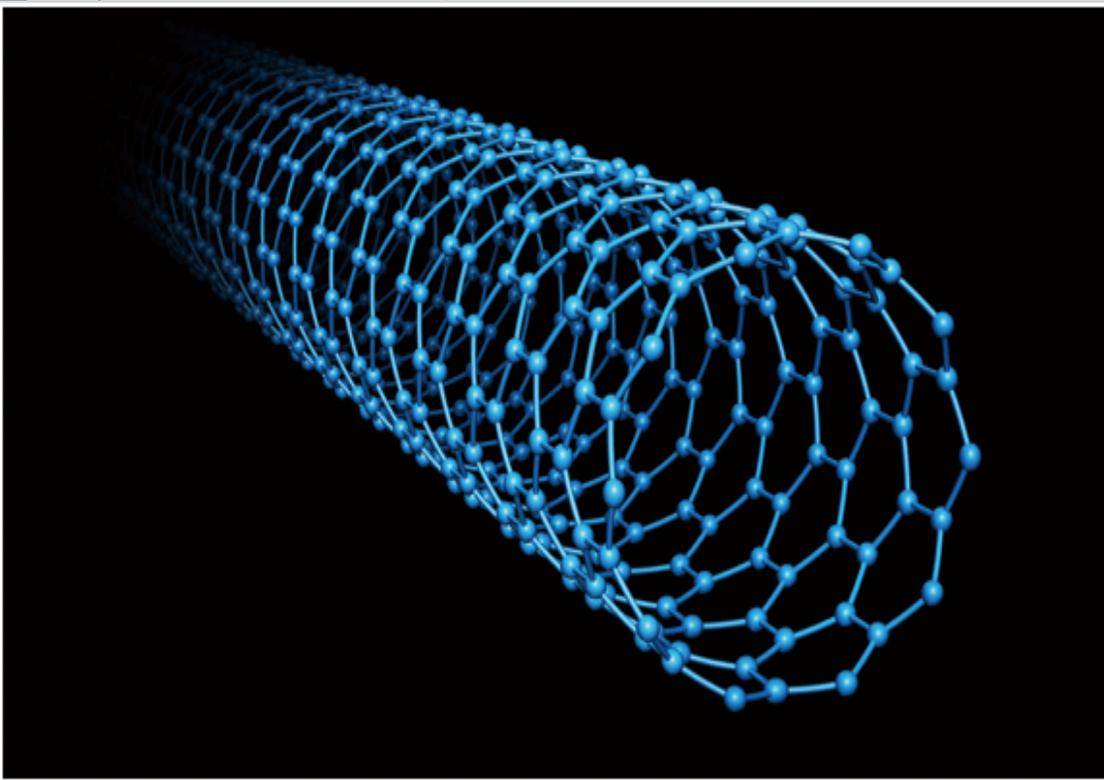


[2]

<https://www.youtube.com/watch?v=p2l-pr--qCU>

Carbon Nanotubes

- ▶ A Carbon Nanotube is a tube-shaped material, made of carbon, having a diameter measuring on the nanometer scale.
- ▶ The graphite layer appears as rolled-up wire with a continuous unbroken hexagonal mesh and carbon molecules at the apexes of the hexagons.
- ▶ Their name is derived from their long, hollow structure with the walls formed by one atom thick sheets of carbon, called graphene.



Nanotechnology applications relating to automotive industry

- ▶ **Functional coatings and lubrication:** self-cleaning, scratch and wear resistance, UV protection, anti-corrosion, oil additives
- ▶ **Nanostructured materials/nanocomposites/nanoparticles:** light weight structure, thermal protection, high strength, greater hardness, noise reduction
- ▶ **Nanotechnology-based energy generation and storage:** fuel cells, solar cells, catalysts, batteries
- ▶ **Data processing and communication**
- ▶ **Sensing and electronics:** motion sensors, airbag sensors, pressure monitoring and security control
- ▶ **Nanodispersed fluids and lubricants:** vibration damping, heat dissipation, reduction of friction and erosion in the engine and gear systems

- It is impossible to confidently list tomorrow's materials for the automotive sector.
- We are in a transitional phase, with producers seeking to introduce new products, or to transfer existing technologies from other industrial sectors.
- Carbon fibres appear to have a big [→]future in the automotive sector.
- An emerging class of new composite materials are based on nanotechnologies such as carbon nano-tubes and inorganic nano-particles.
- There is no doubt that the number of composite material applications within the automotive sector will increase, but they will never completely replace metals.

Nanomaterials in surface coatings

- **Nanoglass coatings** – increasing the quality of glass surfaces (indium-tin-oxide, titanium dioxide)
- Preparation of **hydrophobic glass surfaces** = preventing water deposits and providing clearer view
 - 25 – 300 nm, super smooth
- Also protection against micro-scratches caused by environmental factors



[4]

Polymeric coatings

- Used to **protect** the surfaces of materials **against environmental influences**:
 - UV, moisture, oxygen and pollutants
- These organic films including: polyurethane, resin, polyester, polyamide
- To prevent environmental effects on organic coatings – **different NPs are dispersed in the top coatings** and sprayed on the surface of automobiles (SiO_2 , ZnO)
- = improving of coating hardness, wear resistance, self cleaning abilities

Nanomaterials in interior and exterior parts

► **Nanocomposites** = NPs, nanodots, nanopores, nanofibers in different matrix

————→ stronger, harder, stiffer and lighter materials

Nanomaterials in car fluids

► In automotive are used nanosized boric acid (50 – 100 nm), tungsten nanospheres, copper NPs (in suspension to reduce dumping) and graphene

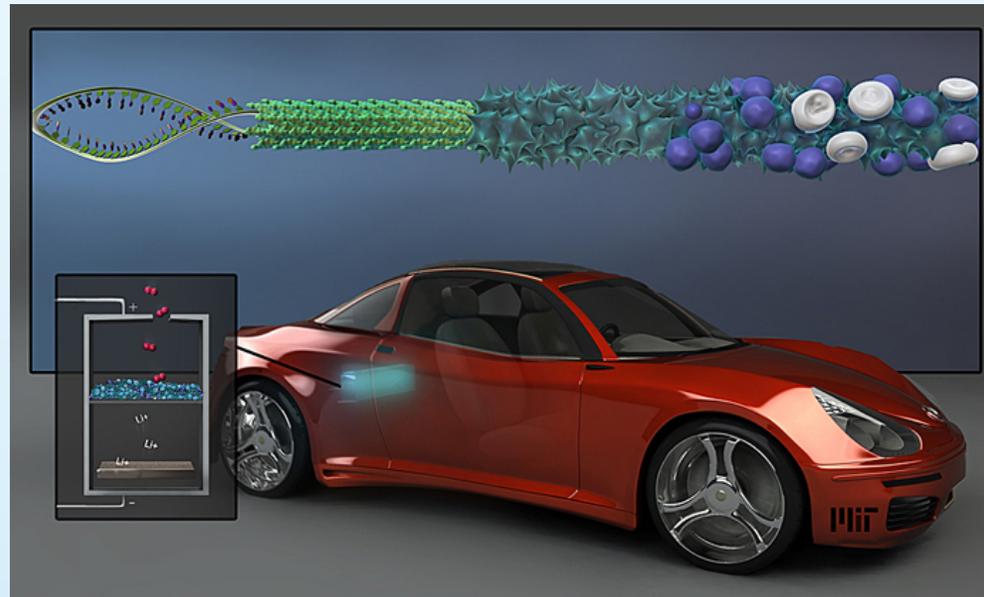
————→ **decreasing frictional resistance, wear, reduce heating and provide more cooling, improve fuel economy**

► Nanoparticles in fluids also extend the life of engine oil by 100 %

Nanomaterials in electronics and batteries

- ▶ New generation of **super-charge lithium-ion-batteries**
 - ▶ Uses high surface area of Si nanowires connected to stainless plate anode
- ▶ Si NWs greatly accelerates the battery's charging and discharging process (10x faster), significantly higher capacity
- ▶ Bendable batteries – coating sheet of paper, plastics with special CNTs ink

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The dream of Freedom and Mobility, Detroit auto show, Mercedes F015 Luxury

Thank you for your attention !!!

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