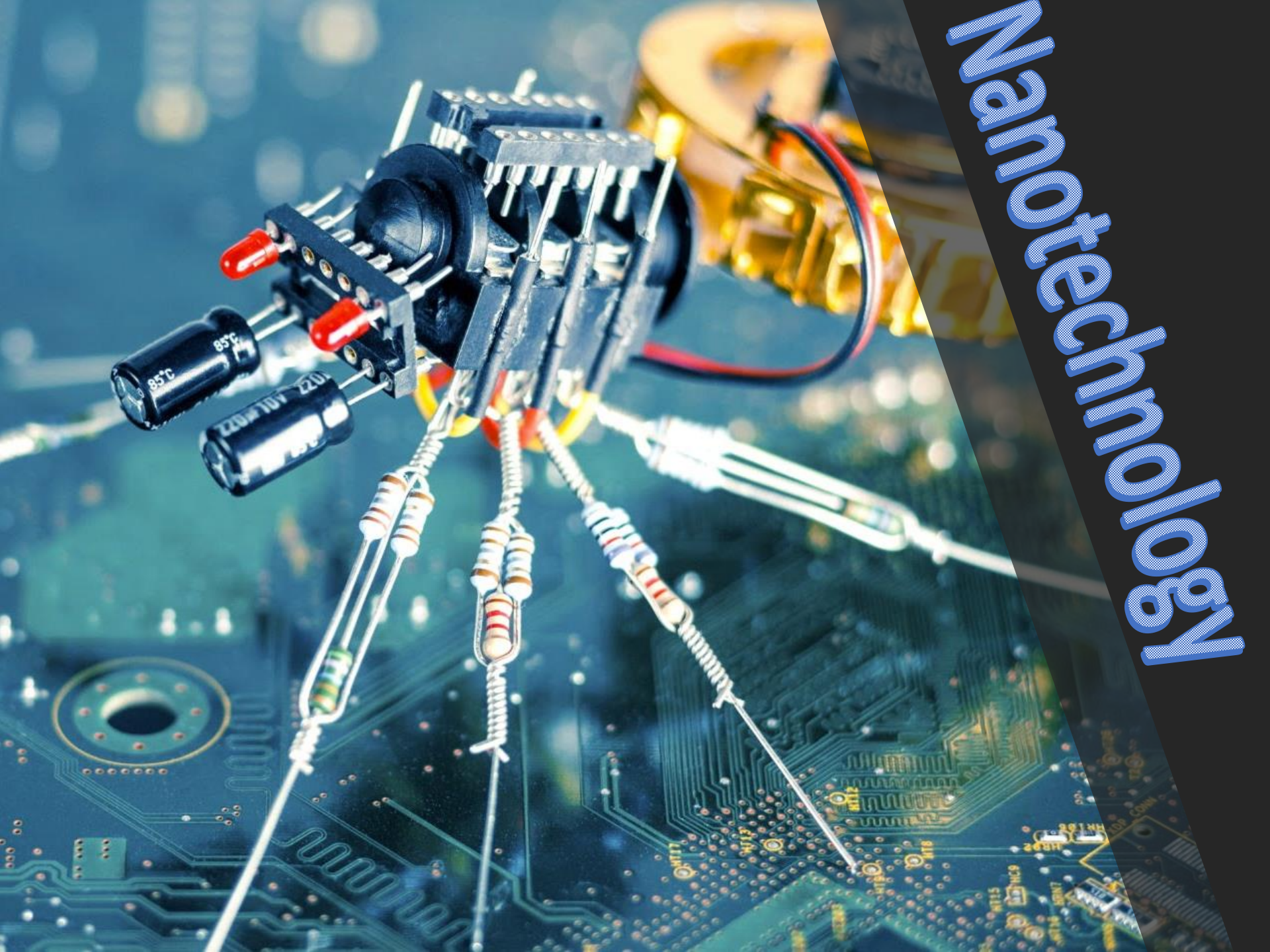


Nanotechnology



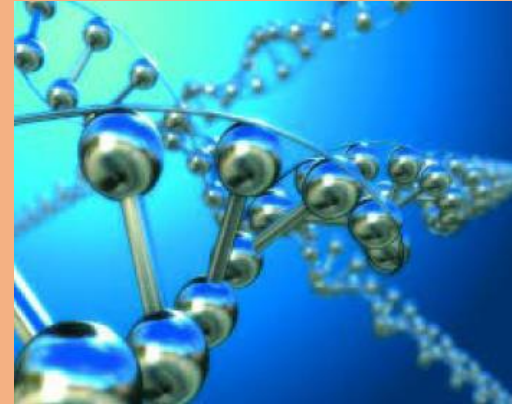
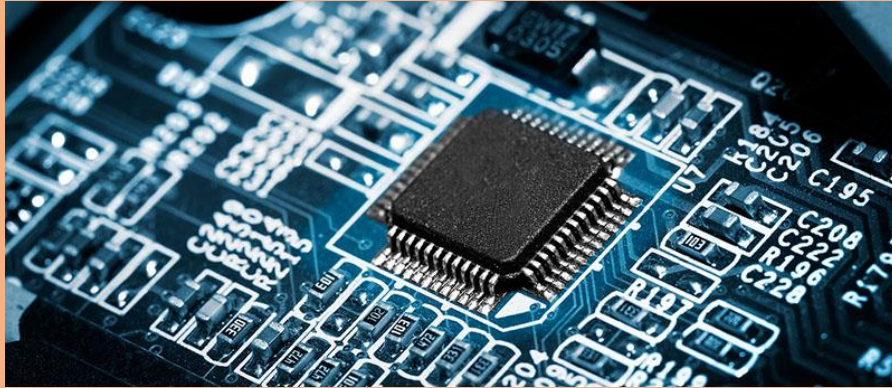
Nanotechnology

Nanotechnology is the manipulation of matter at the near-atomic and molecular (or **nanoscale**) level through engineering and scientific design. Nanotechnology is essential in the production of new materials, structures, systems and devices and seeks to improve functions and reactions of products.



Nanotechnology

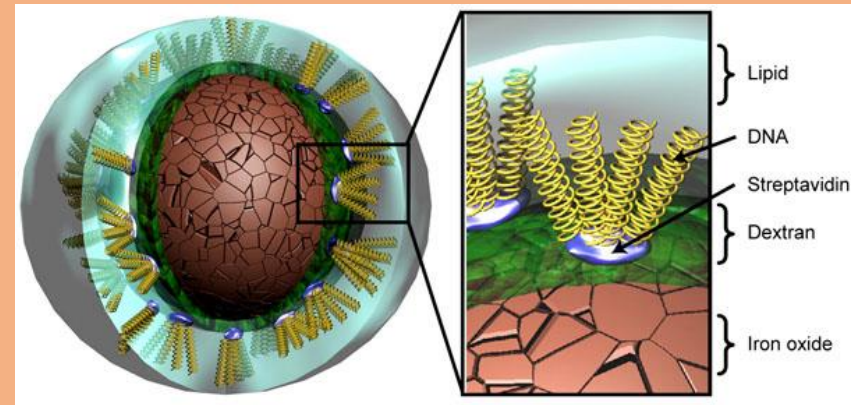
... has potential in a variety of industrial applications such as:



advanced engineering materials

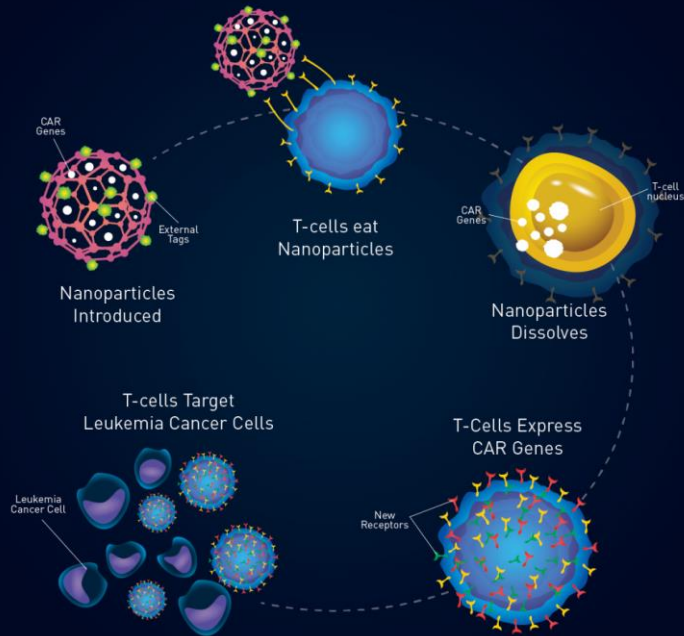


nanomedicine



drug and gene delivery

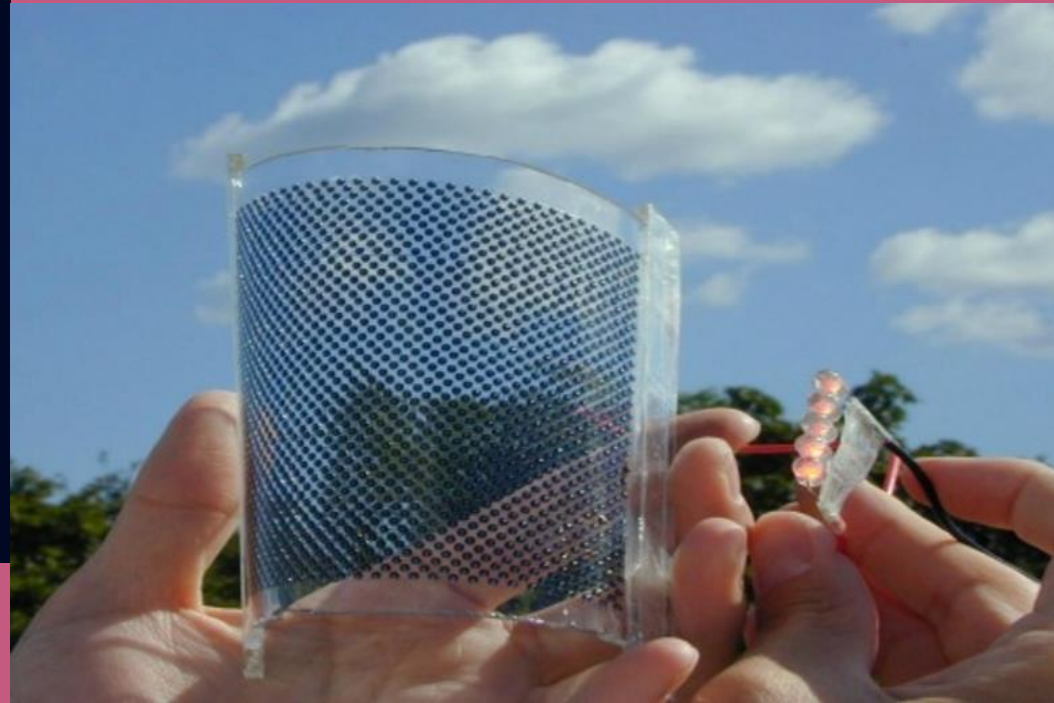
NANOPARTICLE CANCER TREATMENT



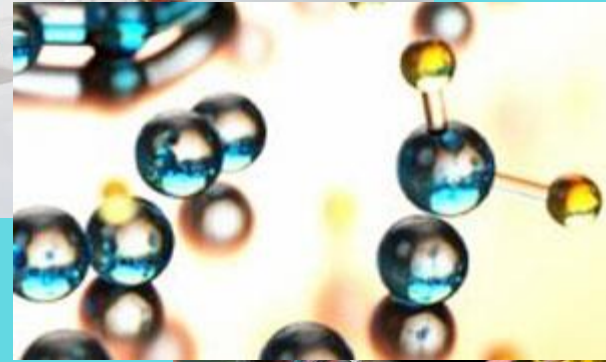
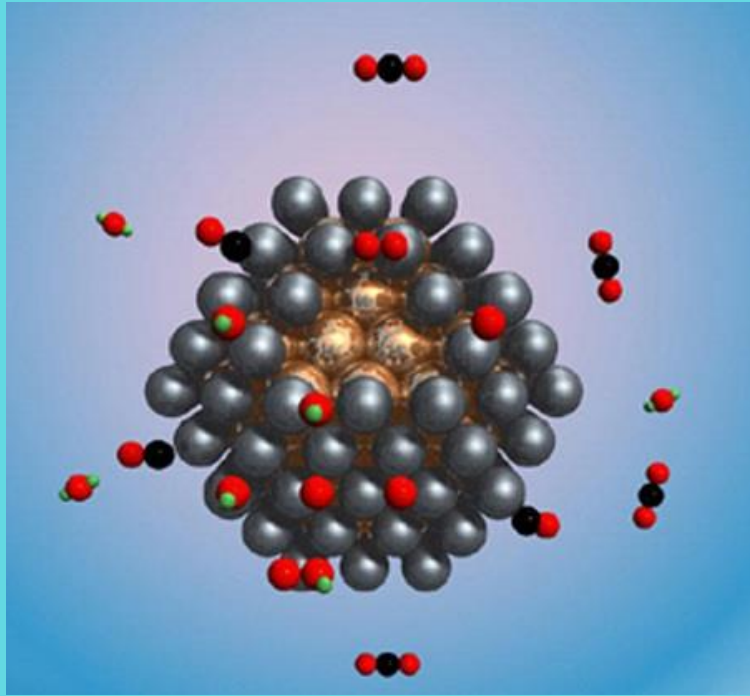
Futurism

Source: "Nanoparticles reprogram immune cells to fight cancer" EurekAlert

imaging and sensors



energy generation and storage materials

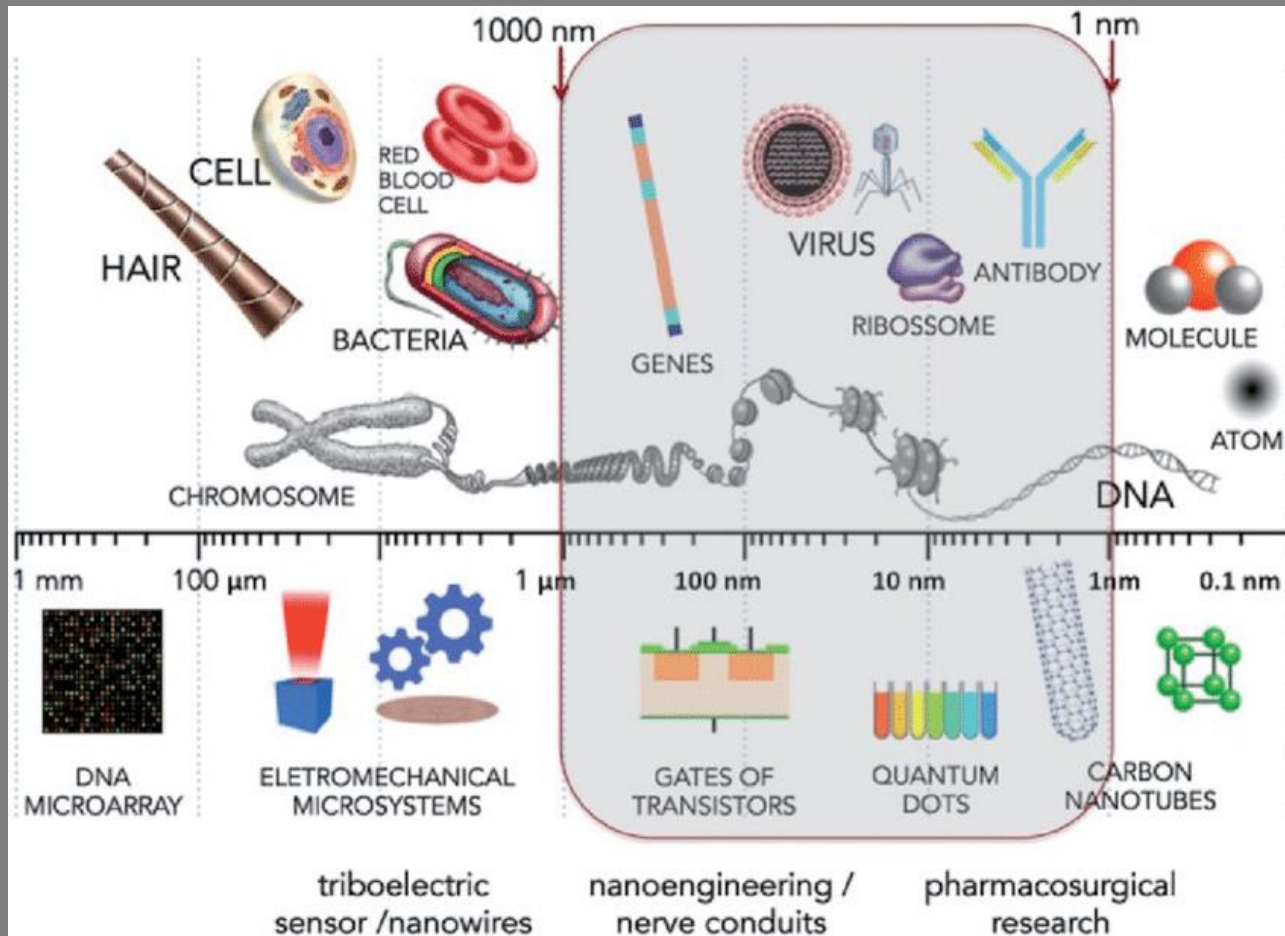


catalysts, foods and personal care products



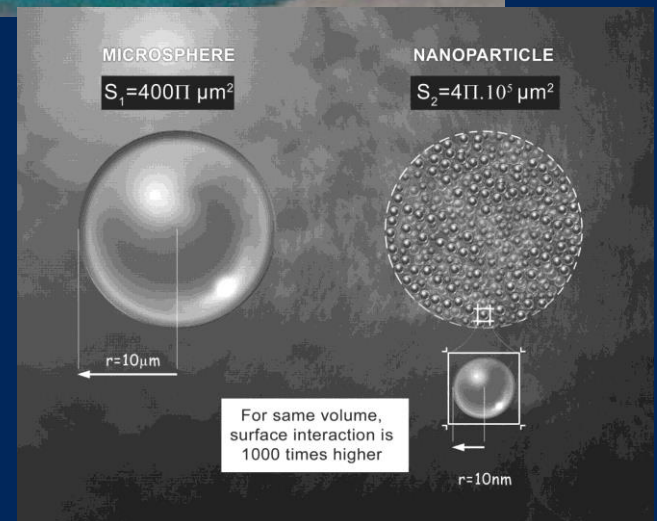
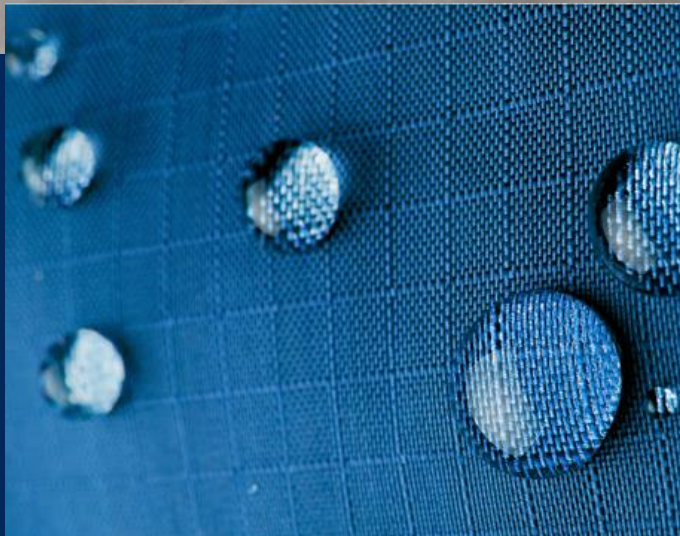
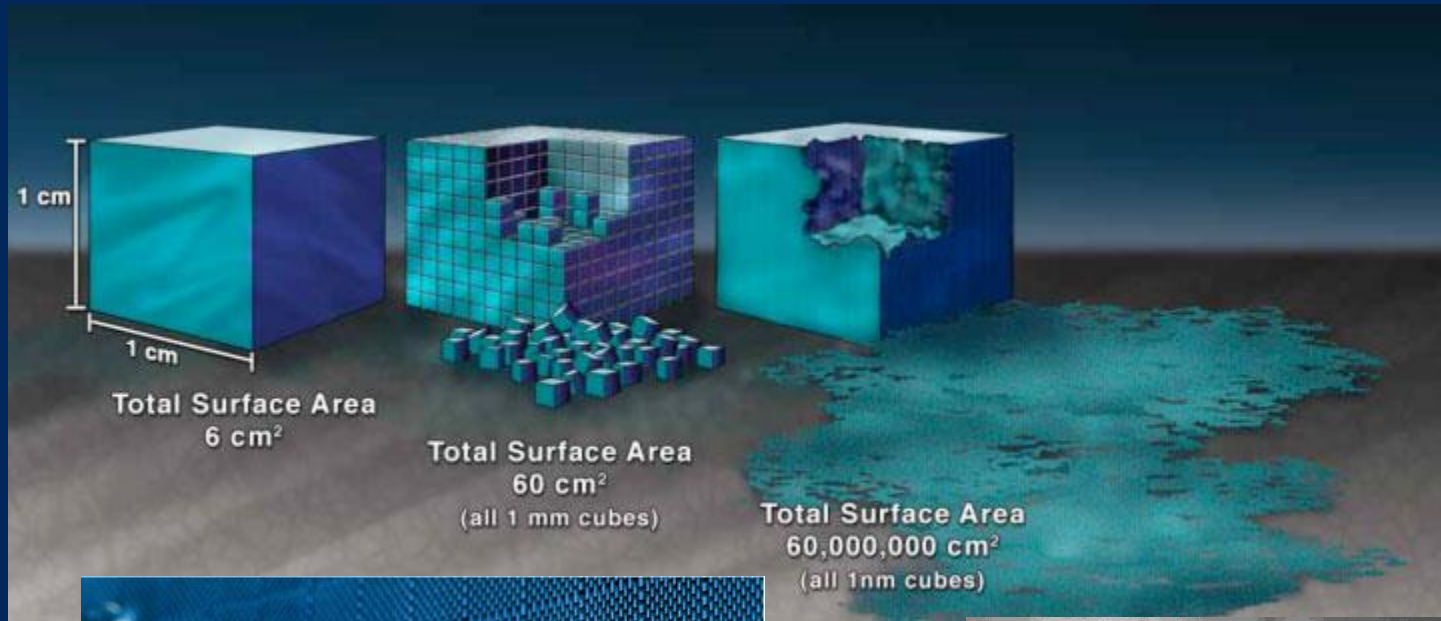
Nanoscale

Nanomaterials typically measure between 1nm and 1000 nm



Nanoscale

At this size, materials begin to exhibit unique properties that affect physical, chemical, and biological behavior



Types of Nanoparticles

Nanomaterials can be categorized in 4 major types:

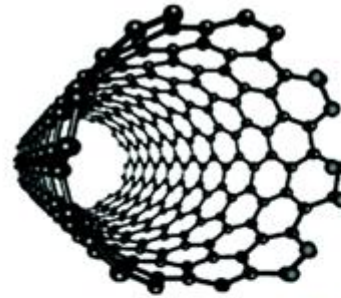
CARBON-BASED



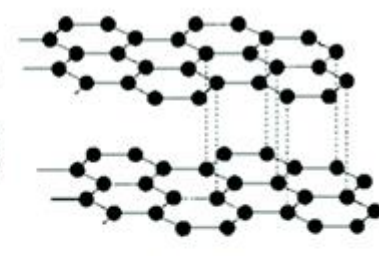
Diamond



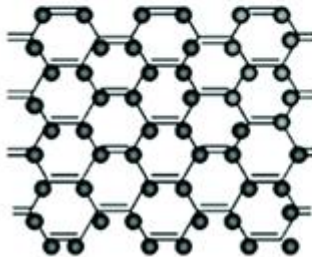
Fullerene



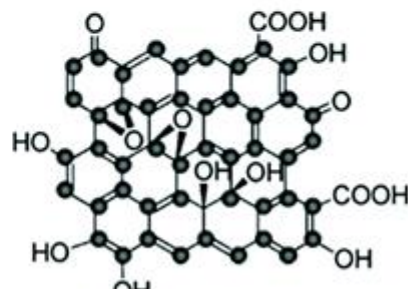
Carbon nanotube



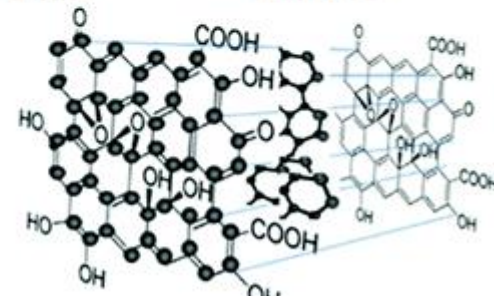
Graphite



Graphene

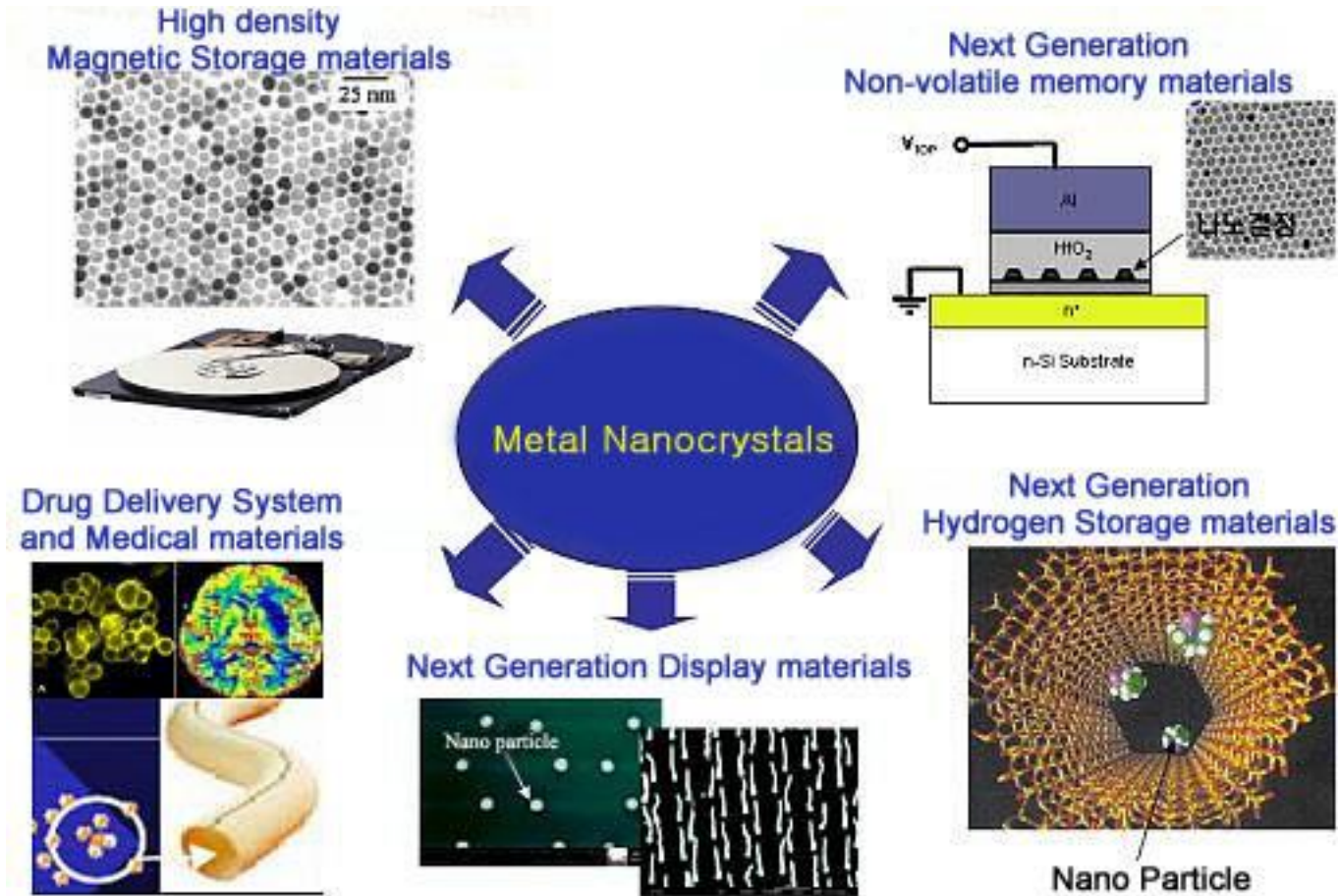


Graphene oxide



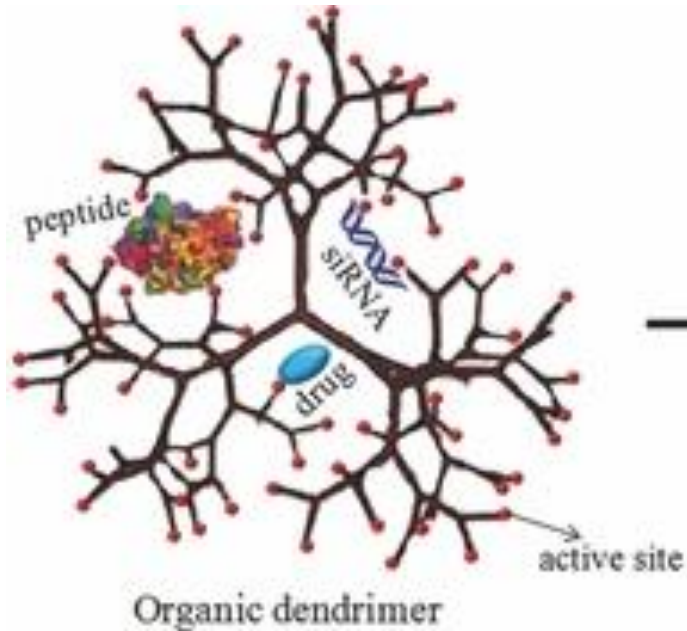
Carbon dot

METAL-BASED

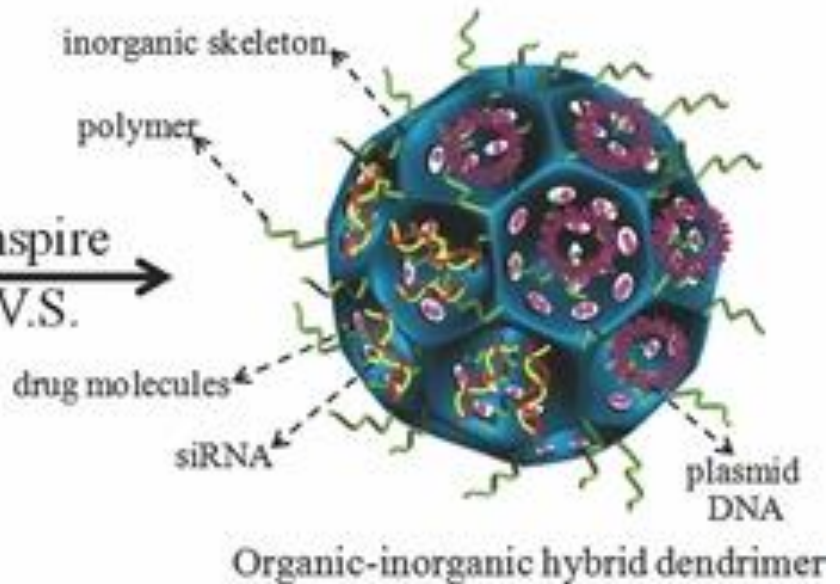


DENDRIMER

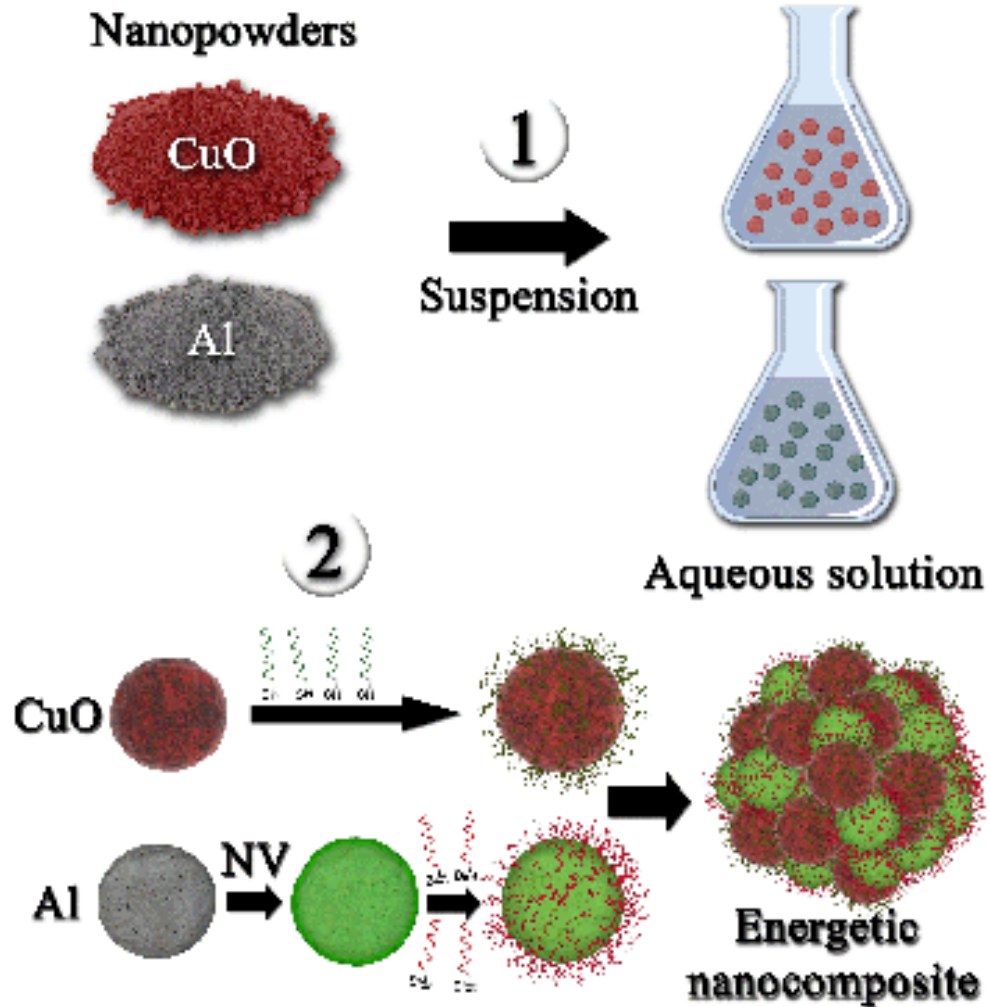
(a synthetic polymer with a branching, treelike structure)



inspire
V.S. →

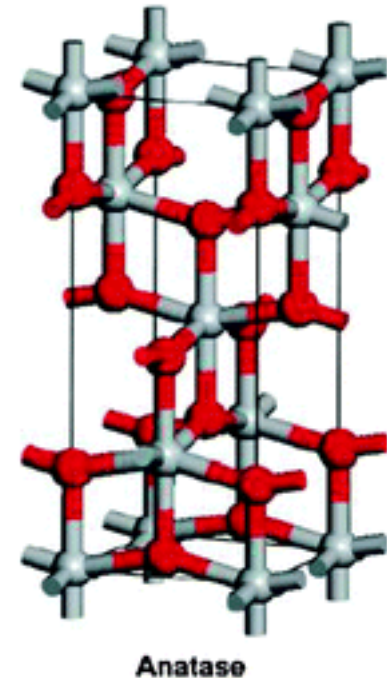
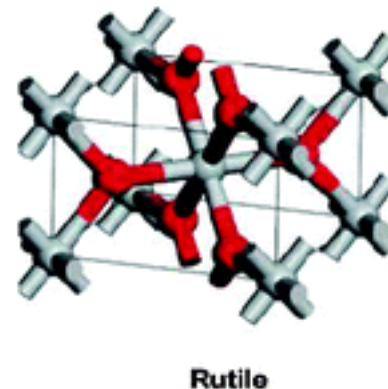
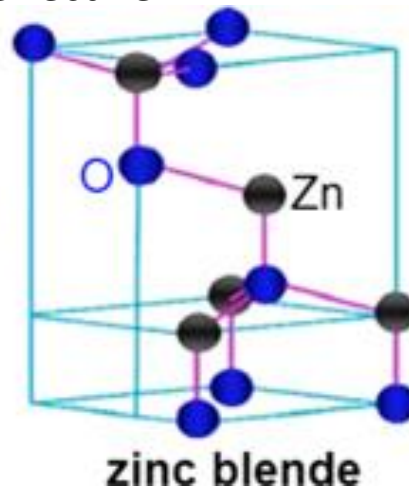
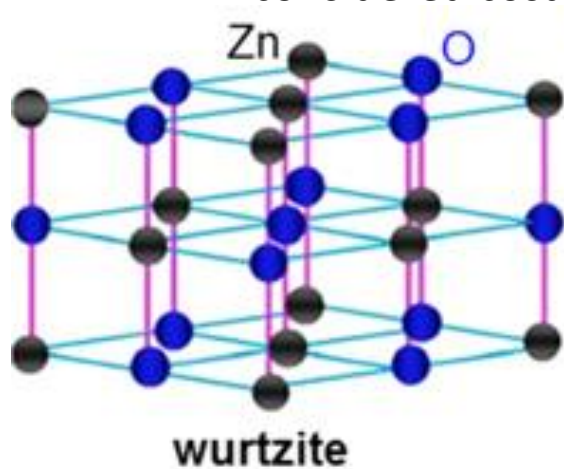


COMPOSITE



Photocatalytic Nanoparticles

Some nanoparticles have photocatalytic properties that scientists can engineer to speed up reactions using a light source. Photocatalytic nanoparticles are organic, may have antimicrobial properties, and are considered cost-effective.



Photocatalysis

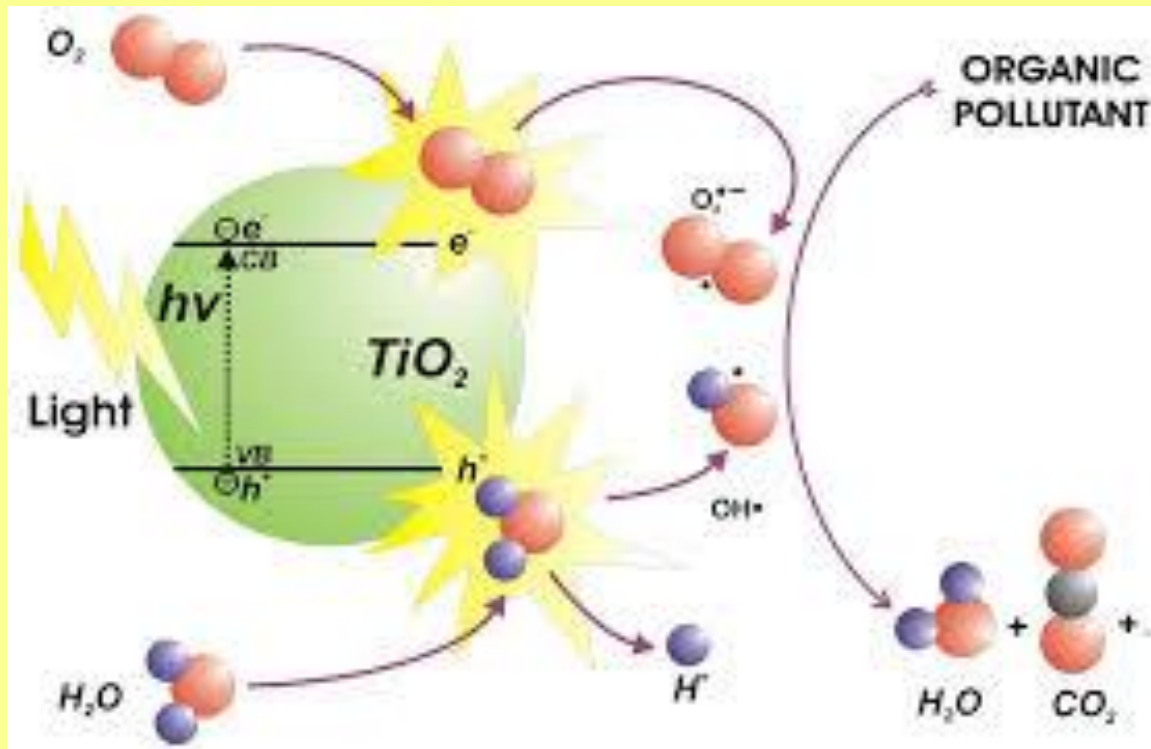
photo = light

catalysis = using a catalyst

catalyst = decreases activation energy to speed up a reaction

Photocatalytic Nanoparticles

These specific nanoparticles have the unique property of acting as a catalyst and speeding up a reaction using a light source (usually UV light).

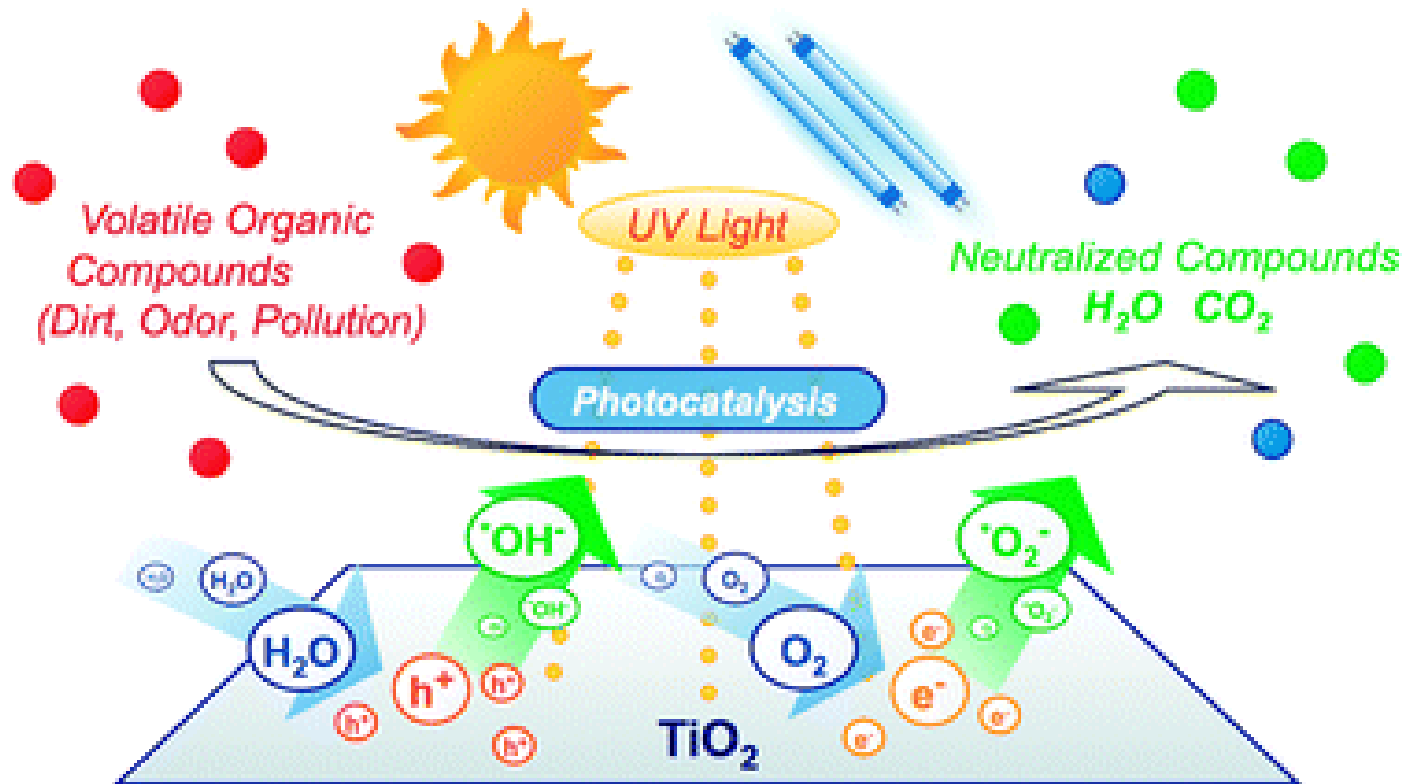


Photocatalytic Nanoparticles

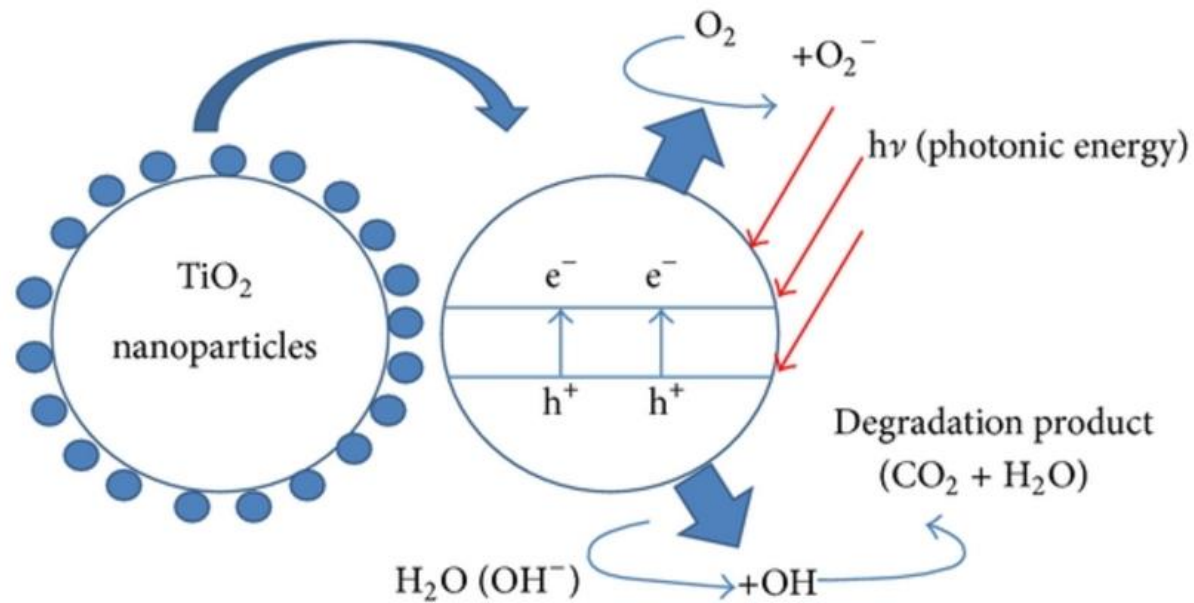
Through this process, nanoparticles such as titanium dioxide, act as organic destroyers and degrade organic toxins in the process of hydroxylation. (A chemical process that introduces a oxygen bonded to hydrogen—or a hydroxyl group—into an organic compound.)



Titanium Dioxide Nanoparticle Photocatalytic Activity



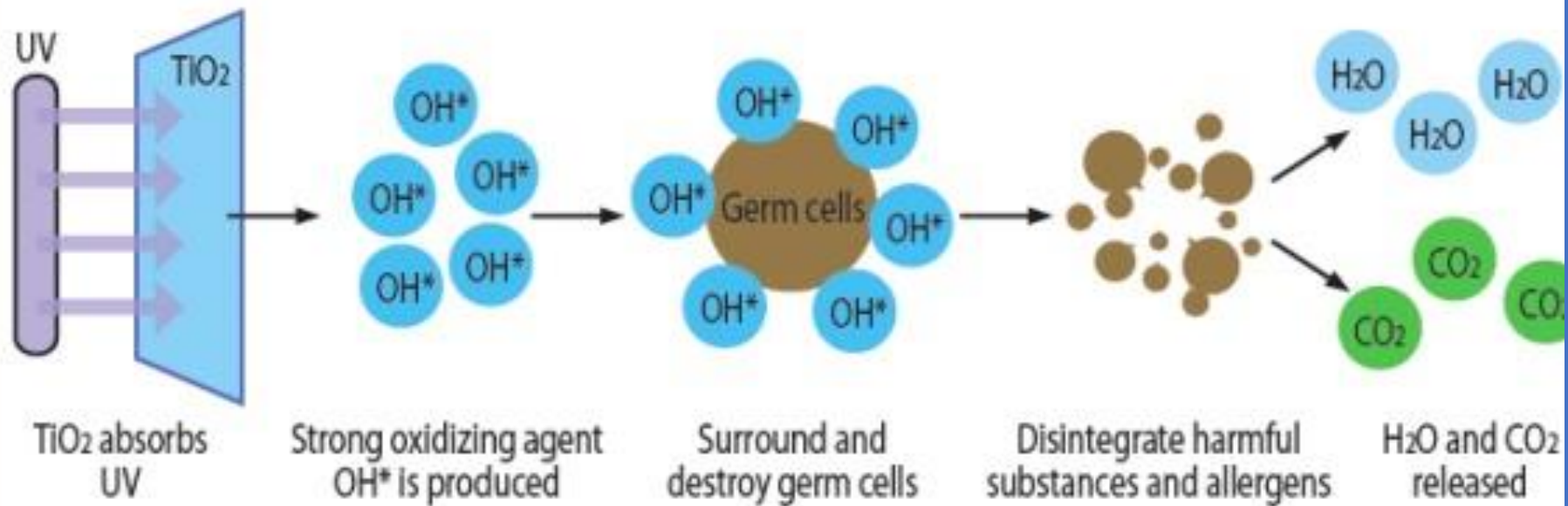
Organic Compounds → photocatalyzed by TiO₂ with UV light → to produce H₂O and CO₂
Organic Compounds → degraded/destroyed in the process through hydroxylation



Photocatalytic Process

Photocatalysts create a strong oxidation agent and electronic holes to break down the organic matter into carbon dioxide and water when in the presence of photocatalysts such as light and water

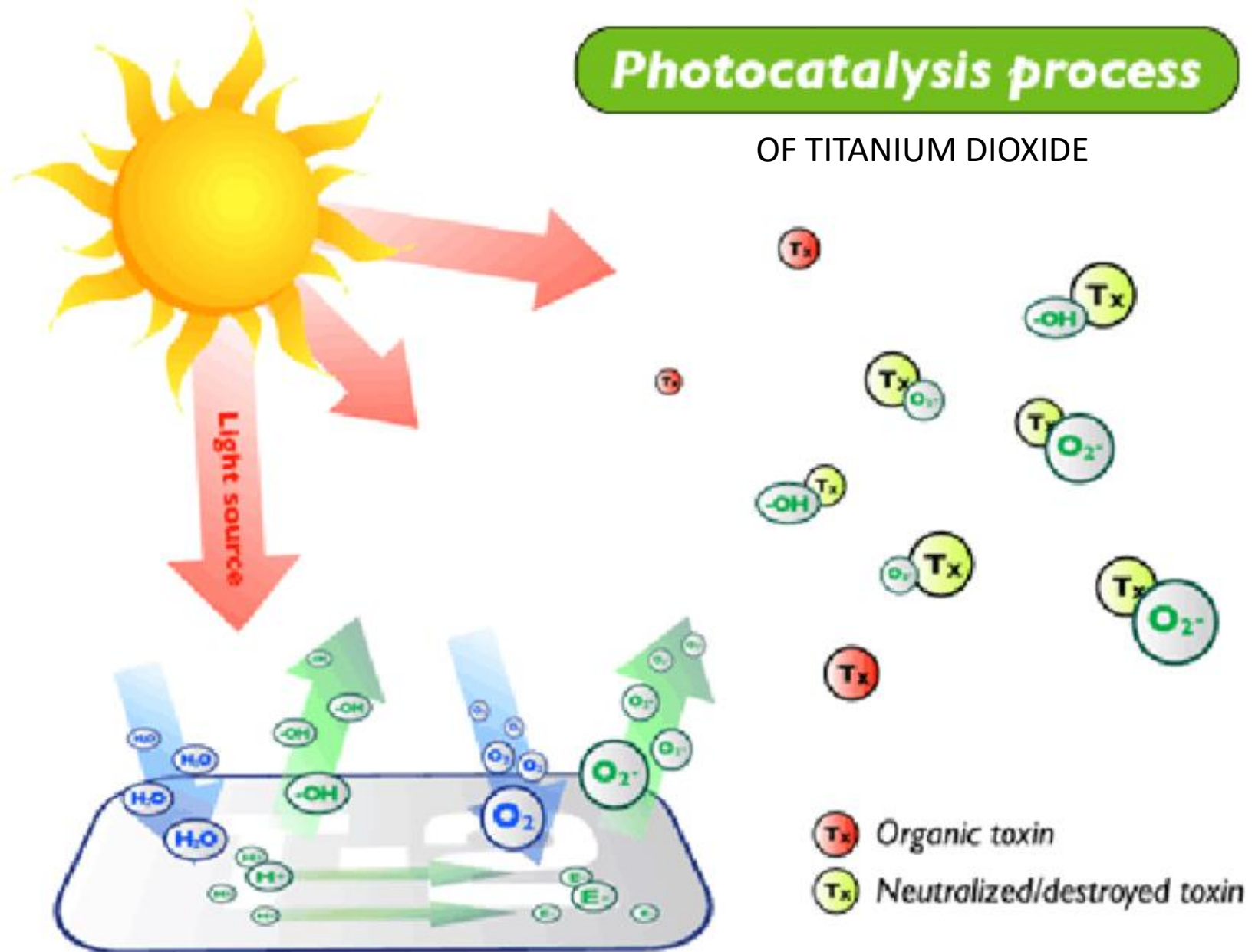
The Process of Photocatalyst Action



HYDROXYLATION TO DESTROY ORGANIC COMPOUNDS

Photocatalysis process

OF TITANIUM DIOXIDE

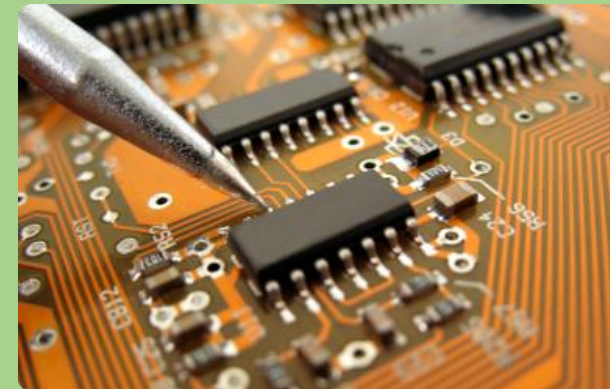


Using energy from light, T-2 creates two oxidation reactants:
hydroxyl radicals and superoxide anion.

These reactants decompose toxic organic substances through oxidation.

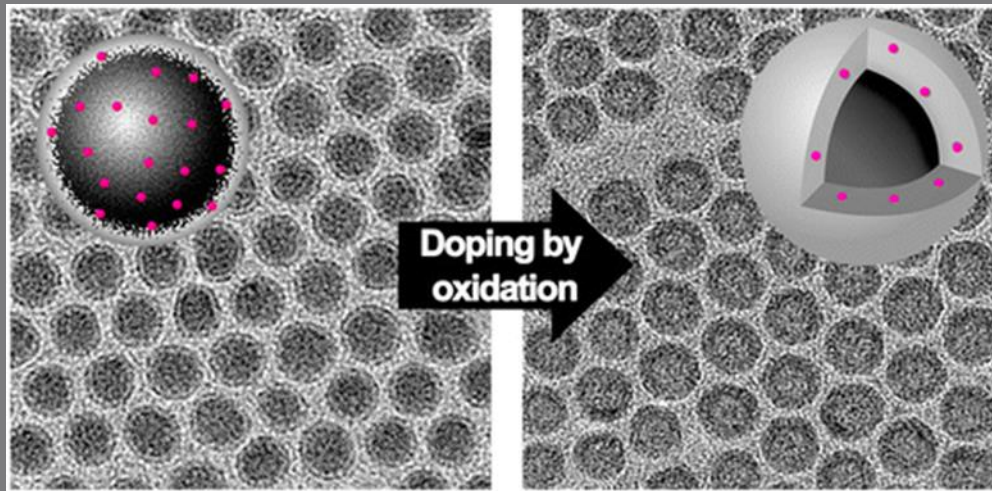
Uses of Photocatalytic Nanoparticles

Nanoparticles are essential in industries such as such as water sanitation and purification. They are also used in products from antimicrobial agents, cosmetics, and sunscreens to semiconductor systems.



Future Research

Photocatalytic nanoparticles are currently being doped (an approach to modulate the electronic and optical properties of nanoparticles) and manipulated to trigger specific properties for nanoparticles in order to build an effective material.



Researching, developing, and utilizing these properties is at the heart of engineering nanoscale technologies.

Image links for each slide (from left to right on the page)
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Slide #	Image 1	Image 2	Image 3	Image 4
1	http://nanodome.info			
2	https://dornsife.usc.edu/news/stories/1111/analyzing-life-on-a-molecular-level/			
3	http://www.drrnlahotipolytechnic.com/course/computer-technology	http://www.european-coatings.com/Raw-materials-technologies/Technologies/Nanotechnology/Layer-by-layer-deposition-of-nano-patterned-thin-films-optimised	https://www.quora.com/What-invention-if-it-were-invented-today-would-quantum-leap-human-technology-by-several-decades-if-not-centuries-overnight	https://www.hopkinsmedicine.org/wilmer/research/retina/lutty/nano.html
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5	https://news.wisc.edu/new-nanoparticle-catalyst-brings-fuel-cell-cars-closer-to-showroom/	https://nanofixit.wordpress.com/2015/04/28/nanotech-foods-will-nanotechnology-change-what-you-eat/	http://www.european-coatings.com/Raw-materials-technologies/Technologies/Nanotechnology/What-do-people-know-about-nanotechnology	https://www.101newsmedia.com/news/16693
6	http://blogs.iu.edu/sciu/2017/03/28/nanomaterials-bacteria/			
7	https://www.nano.gov/nanotech-101/special	https://www.asme.org/engineering-topics/articles/nanotechnology/nano-advancement-repels-liquids	https://www.acast.com/pulseoftheplanet/nanoparticles-awholelotofsurface15may17	
8	https://www.cd-bioparticles.com/t/Properties-and-Applications-of-Carbon-Nanoparticles_61.html			

Slide #	Image 1	Image 2	Image 3	Image 4
9	http://composite.kaist.ac.kr/cgi-bin/reseng2.pl?metalnano			
10	https://chemeng.adelaide.edu.au/qiao/publications/previous/			
11	https://www.laas.fr/public/en/dna-nano-engineered-reactive-materials			
12	http://iopscience.iop.org/article/10.1088/2043-6262/6/3/033002	http://pubs.rsc.org/en/content/articlelanding/2013/cp/c3cp43938k/unauth#!divAbstract		
13				
14	http://www.mdpi.com/2073-4344/3/1/189			
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17	https://www.researchgate.net/profile/Chin_Wei_Lai2			
18	https://sciencedatacloud.wordpress.com/2013/11/22/photocatalyst-technology/			
19	https://www.researchgate.net/figure/Mechanism-of-titanium-dioxide-photocatalytic-degradation-process_fig3_215721240			
20	https://www.cdc.gov/healthywater/global/index.html	https://www.medexpressrx.com/blog/kids-shouldnt-avoid-using-sunscreen.aspx	https://csl.illinois.edu/news/metagenomic-research-studies-effects-microbial-populations	http://www.voicendata.com/worldwide-semiconductor-revenue-grew-2-6-percent-in-2016-gartner-results/
21	http://www.lnls.cnpem.br/successful-oxidation-induced-doping-of-nanoparticles-revealed-by-in-situ-xas/			