

22CHM 3150 Fullerenes, Nanotubes and Nanotechnology

This is a place to share something interesting about nanotubes or nanotechnology in general. Give your entry a title, add your name, and summarize your findings IN YOUR OWN WORDS in a few sentences. Don't forget to cite your source so we can follow up to learn more (right-click to add a Link, or copy/paste url).

"Nanotechnology's Big Impact" [ChemMatters article](#)

- Nanotech Title (Your Name) Tell me all about it... <http://add-a-link-too>

New class of nanoparticles (Bruce Rhee)

The focus of this new study is examining a new class of organic nanoparticles that share novel features of inorganic counterparts. The study was centered around observing the impact of hyperbranching and chemical cross-linking of organic nanoparticles, and how in combining the processes, achieves a dense bonding network. The results of the study display a capability to regulate functional attributes and elastic properties, opening new avenues for a wide range of applications, a notable example being more versatile graft modification. The advanced manipulation of the oNPs was made possible by atom transfer radical polymerization, a new technique developed by Rongguan Yin. Further studying of these nanoparticles may lead to unlocking even more innovative applications of nanomaterial technologies through direct assembly or integration.

<https://engineering.cmu.edu/news-events/news/2024/07/12-organic-nanoparticles.html>

How to build nanomaterials (Sofia Flores)

While reading the document I was able to learn about building nanomaterials. In order to build nanomaterials, you need to understand the two ways to do it. The first way is by modifying starting material which is known as the "top-down" approach. Using this method, you are altering it mechanically or chemically. An electron beam is then used to create small structures. The second method is known as the "bottom-up" approach which starts with individual molecules or atoms and then brings them together to form a product where each atom is in its designated location.

Spherical Particle (Dayra Magdaleno)

I learned about spherical particles and their significance in the drugs/medicine industry. It turns out that the shape of the particle, which in this case is a sphere, is created to allow the release of the drug in all directions in its environment. The article describes this particle in the intestinal lining. The sphere allows for the drug to be able to reach the lining in all directions. As a result, this allows for a steadier drug release that can last a lot longer and be more efficient.

https://www.sciencedirect.com/science/article/pii/S0168365907001769?casa_token=UnLstHayLX4AAAAA:oluSlhsbk8hea-LKu1TVQUw2PsEJX13FoXpIS74nO2HAHbxW8puSr5picUdns_nSzkMUAJCJQw

Buckyball (Vanessa Arellano)

Nano balls are hollow shaped molecules that are made up of 60 carbon atoms. These nano balls are termed as buckyballs as well in which develops products for health care. Bucky balls have used to block inflammation ,swelling and pain associated conditions. This technology is based on Buckyball's ability to trap radicals which increases inflammation and can kill or damage cells

Carbon Nanotubes: properties and application (Kushi Kakkar),

<https://www.sciencedirect.com/science/article/abs/pii/S0927796X03001268>

The carbon nanotube collection of shells closely resemble how honeycombs are arranged. These nanotubes have high tensile strength, which makes them super ideal for composite materials which have improved mechanical properties in electronic devices like field-effect transistors. Additionally, another interesting fact I learned is that multiwall nanotubes have been used to electrocatalyze an oxygen reduction reaction, which is important for fuel cells. They have been used for battery electrodes.

Gold Nanoparticles (Sara Rearick)

Gold nanoparticles are used in many different settings. In electronics, they are used to connect resistors and conductors. In photodynamic therapy, light is applied to a tumor containing gold nanoparticles. They can rapidly heat up and kill the tumor. These gold nanoparticles are also able to be coated with molecules for therapeutic drug delivery. Gold nanoparticles are also used as catalysts in chemical reactions. With this characteristic, they are being developed for fuel cell applications. Gold nanoparticles have many different uses in chemistry, biology, and engineering.

“Gold Nanoparticles: Properties and Applications”

https://www.sigmaaldrich.com/US/en/technical-documents/technical-article/materials-science-and-engineering/biosensors-and-imaging/gold-nanoparticles?srsltid=AfmBOordnvnB_6UFAUIXoy1xFaxNWtOyWwfrT_H_hTqUEfAPb4qvzc-1

Nanotubes (Andree Campugan)

Nanotubes are similar to the spherical C60 carbon molecule that was first discovered in the 1980s. Their structure is similar to the Buckyball, but the length differs by 1-2 nm in diameter. Nanotubes are formed by carbons arranging in a single layer while creating a cylindrical shape. While in their simplest form they are called single-walled carbon nanotubes. However, they can also form multiwalled tubes that have larger diameters up to 20nm and lengths that exceed 1mm. These nanotubes are stronger than steel and have a very large surface area which makes them the strongest out there!

Nanotube.

<https://www.sciencedirect.com/topics/materials-science/nanotube>

Nanoparticles for Drug Delivery (Sophie Biehler)

Recent studies have allowed researchers to engineer lipid-based, polymeric and inorganic nanoparticles optimized for drug delivery in a more precise way, which allows the world of medicine to enter an era of precision medicine. There are numerous different ways that researchers have been able to utilize different nanoparticle designs for both non-personalized and personalized applications. This introduction of nanoparticles for drug delivery ultimately impacts the overall quality of life for patients.

Engineering precision nanoparticles for drug delivery

<https://www.nature.com/articles/s41573-020-0090-8>

Nano-in-Nano (Jorge Lopez)

This article reviews the role of nanofibers in advancing cancer treatment. These nanofibers allow for targeted, controlled drug release, enhancing chemotherapy efficacy while reducing side effects. The review covers their applications in various therapies, including gene therapy, photodynamic treatment, and highlights their potential to improve cancer diagnostics and therapeutics. It also goes over the different current obstacles and future directions for clinical use of nanofiber-based treatments.

<https://www.sciencedirect.com/science/article/pii/S1773224723011012>

Nanomedicine fights against cancer (Ryan Chu)

The article talks about how nanomedicine is advancing enough to be used to target cancer in a number of different ways. Nanomedicine can be used to act as contrasting materials on tumors to highlight said tumors on examinations, or nanotech can help to deliver medicine directly to the tumors for treatment. From this, we can see that nanotechnology is advancing to the point where it can be used in the detection of and treatment of malignant tumors.

Current advance of nanotechnology in diagnosis and treatment for malignant tumors

<https://www.nature.com/articles/s41392-024-01889-y>

Nanotechnology development in surgical applications: recent trends and developments (Anthony Pena)

The use of nanotechnology in a surgical setting has revolutionized procedures through surgical tools, suture materials, imaging, targeted medication therapy, visualization techniques, and wound healing approaches. While it is slowly being introduced into the clinical setting, significant improvements have been made, creating a promising future for nanotechnology. With improved patient care and quality, quality of life for many individuals may increase.

<https://pubmed.ncbi.nlm.nih.gov/38001554/>

Nano-hydroxyapatite (Kassandra Alvarado)

Nano-hydroxyapatite is the main component of enamel and is used in dentistry. This article discusses the advantages of this nanotechnology in its ability to bind with proteins, plaque, and bacteria to repair holes and depressions on the enamel surface. As a source of calcium and phosphate, nano-hydroxyapatite in toothpaste is vital for the remineralization of damaged enamel areas. This is often also used in the reconstruction of bone defects and the protection of teeth by creating a layer of synthetic enamel around the tooth as an alternative to fluoride.

<https://pmc.ncbi.nlm.nih.gov/articles/PMC4252862/>

Food and nanotechnology meet in unique milk protein-based nanotubes (Nadtine Ngnibogha)

This article highlights how partial hydrolysis of the milk protein alpha-lactalbumin by protease from *Bacillus licheniformis* results in the building blocks which are self-assemble into nanometer sized tubular structures. The application of nanotechnology in the food industry is very interesting because of all the benefits and new promises nanotechnology has to offer; such as new ingredients which will be made by using nanostructured materials. Something I found interesting within this article is how alpha-lactalbumin has an extraordinary cavity that could serve as vehicles for drugs or other encapsulated molecules, such as for vitamins and enzymes, or even as a mask encapsulated compounds. Which is why milk proteins alpha lactalbumin is known to lead to long straight nanotubes, which withstands some important treatments such as heating and mechanical deformation.

<https://www-sciencedirect-com.proxy.library.cpp.edu/science/article/pii/S0924224405003547?via%3Dihub>

Application of some nanoparticles in the field of veterinary medicine (Think Le)

This article was really interesting to me because it highlighted the importance of how nanotechnology can be used in modern medicine. In this case, focusing on the field of veterinary medicine. It talks about the usage of nanoparticles in the field of pharmacology and how it is considered an ideal drug delivery system that would enhance wound healing and reduces pain. And these new compounds are made so that they will deliver the drugs and medicine directly to the targeted tissues and organs.

<https://pmc.ncbi.nlm.nih.gov/articles/PMC6968591/#:~:text=Nanoparticles%20in%20the%20field%20of%20pharmacology%20are%20considered%20an%20ideal,the%20target%20tissues%20and%20organs.>

Nanomedicine (Jailene Aguila)

This article explained what nanomedicine is and the effect nanotechnology can make on medicine. It's developed by a material at its nanometric scale and this size can potentially cross natural barriers to interact with DNA. Nanomedicine can help with early detection and improve diagnosis and better treatment plans for diseases like cancer. Nanomedicine has the potential to improve drugs and treatments and can also be a tool to provide better affective healthcare.

<https://etp-nanomedicine.eu/about-nanomedicine/what-is-nanomedicine/>

Nanoparticle Approach Enhances Detection of low-Abundance Proteins in Blood Plasma (Michael Caira)

This article describes how scientists can analyze and quantify more proteins in plasma. Thus they will be able to analyze, profile, and discover possibly new biomarkers. This improvement in nanotechnology will allow scientists to produce new kinds of medicines and allow for a better understanding of how blood plasma works and what components contribute to its ability to do its job.

<https://phys.org/news/2024-11-nanoparticle-approach-abundance-proteins-blood.html>

New Nanomaterial for Retinal Implants Could Someday Help Restore Sight for Millions [Elianna Aragon]

Retinitis pigmentosa is a genetic disorder that affects millions of people by slowly damaging photoreceptor cells in the retina ultimately, causing blindness. John Hopkins researchers, Emad Boctor and Seth Billings, believe that nanotechnology can help with bypassing damaged retinal cells and restore a certain percentage of eyesight. They are currently developing a retinal implant utilizing nanomaterial and plan to 'activate' it with the use of a laser. As a result, they claim that the activation will send sound vibrations and reach retinal cells that aren't damaged overall, having it send signals to the visual cortex potentially allowing the brain to interpret images.

<https://malonecenter.jhu.edu/new-nanomaterial-for-retinal-implants-could-someday-help-restore-sight-for-millions/>

Nanoenzymes in disease diagnosis and therapy (Kathryn Kugel)

Nanoenzymes have the potential to be used in the detection of disease development or be used as a preventative measure against chronic inflammation and oxidative damage, both of which are proven to increase the likelihood of cancer in a patient. Nanoenzymes are nanomaterials with enzyme-like properties, but are controllable by altering size, shape, and function. Size and shape, as well as the environmental conditions, have been shown to affect the performance of nanoenzymes, much like naturally occurring enzymes. They are versatile and can be based on many different compounds, which may allow them to be more accessible for treatment.

Nano-drug delivery (Jamie Cortez)

Nano-drug delivery is an advancement in technology that is being created to solve various health care issues that seem to arise often in the drug industry. The most common issue that patients seem to encounter is the inability to swallow pills steering patients towards the syrup solution of the drug. According to the National Library of Medicine syrup medications tend to diminish in effectiveness when consumed regularly, and this is true for capsules as well. This is due to the impact these medications have on the body allowing for toxins to be released in the bloodstream. Nanomedicine provides the ability to control the amount of medication released into the body as well as being able to get it to the needed location in the body while avoiding unnecessary damage to cells.

<https://pmc.ncbi.nlm.nih.gov/articles/PMC9781272/>

Nanotubes Thermal Gaskets for cooling technology. (Adrian Rodriguez)

Nanotube technology is being applied not only to medical but also to mechanical and electrical technology. With nanotubes not only can we reduce the weight of coax cables but also assist with heat sinks and increase the amount of heat that is dissipated through electrical components. "Within a square inch of a pad of nanometer diameter carbon nanotubes, you're going to have greater than 400,000 contact points that help transfer heat," Silverman. This means in aerospace technologies can increase performances of planes and space vehicles. CPUs can have more capacity to carry heavier loads of computing power and Increase all capacity of electronics.

<https://www.northropgrumman.com/what-we-do/advanced-technology-and-innovation/five-innovations-made-possible-with-carbon-nanotubes>

Nanoparticles contribution for environmental remediation. (Jordyn Scott)

Engineers have developed a thin film membrane with pores for energy-efficient desalination of water. This molybdenum disulphide membrane filtered two to five times more water than current conventional filters and is more cost-efficient than conventional filters. Scientists are developing nanoparticles that induce chemical reactions to clean industrial water pollutants in groundwater, which is more cost efficient and effective than the current tactic of pumping water out of the ground for treatment. Nanotechnology-enabled sensors and solutions are being developed to detect harmful chemical or biological agents in the air and soil at a higher efficiency. <https://www.nano.gov/about-nanotechnology/applications-nanotechnology>

Advanced applications of nanotechnology in veterinary medicine (Luna Quezada)

The various types of nanoparticles have been found to have many applications in the veterinary field depending on their qualities. Liposomes can be conjugated to animal antibodies to attack malignant cells and can be used to improve the efficacy of vaccines. Nanotubes can be used in cancer diagnoses and gene therapies by detecting low antibody concentrations in an animal's blood. They are also applied to animal nutrition and breeding for production purposes. Nanominerals help control pathogens and rumen fermentation processes, while promoting growth and stimulating the immune system. Nanotubes can be used in estrus detection, directing bull sperm to the oviducts, and determining if there are any genital/urinary infections.

<https://link.springer.com/article/10.1007/s11356-018-3913-y>

Using fungi to synthesize nanoparticles in a more environmentally friendly way/ application of silver nanoparticles to control mosquito egg vitality. (Celeste Perdomo)

I looked up recent nanotechnology on One Search on the school library page. I found, The Journal of Fungi published in 2022. All the articles included how nanotechnology has been recently synthesized using different fungal strains due to their high heavy metal tolerance. In one article titled "Mycosynthesis, Characterization, and Mosquitocidal Activity of Silver Nanoparticles Fabricated by *Aspergillus niger* Strain" the authors used metabolites of fungi strain *Aspergillus niger* to synthesize Ag-NPs (nanoparticles) with a biomass filtrate. Using XRD and TEM analysis they found that Ag-NPs have a range of sizes between 3-13 nm with a crystalline and spherical shape. The authors briefly incubated 7 separate groups of eggs (6 experimental and 1 control) for 24 hours containing 0.5 L dechlorinated water with various concentrations of Ag-NPs in glass cups. The results showed that concentrations of 25 and 30 ppm of Ag-NP's caused complete egg mortality. Therefore synthesizing Ag-NP's using fungi strain *Aspergillus niger* is much more environmentally friendly than chemical formulation and still effective towards mosquito.

https://mdpi-res.com/bookfiles/book/7353/Fungal_Nanotechnology_20.pdf?v=1731377225

Nano Drug Delivery (Jose Rodriguez)

With modern advances in medical technology many scientists have been able to combat diseases like Covid19 and cancers. On the forefront of these medical advances there are scientists that take technology to the next level. For instance Tejal Desai, of the University of California at San Francisco is developing nano technology to be able to deliver medicine more effectively to specific parts of the body. With further advances in nano technology certain aspects of medicine like amount delivery and how fast the medicine takes to take effect are no longer something to take into account. However it is still debated whether nano technology is safe to use due to the lack of research available. This should propel future aspiring scientist to engage in this research in order to further the advances in this interesting field

Synthesis of Nanomaterials, In a Nutshell (Juan Maldonado)

A topic that I found particularly fascinating involves the development of new methods to synthesize nanomaterials. One method is known as the "Top-Down" approach, in which a material is altered via chemical or mechanical means. Common methods of achieving this are through electron beam lithography, which involves a focused beam of electrons that form the circuit patterns needed for depositing material on or removing material from a surface, and photolithography, which uses light for this same purpose. Conversely, the second method is known as the "Bottom-Up" approach and it starts with individual molecules or atoms and brings them together to form a product in which every atom is in a designated location. Often molecules are designed and created so that they can spontaneously self-assemble when a chemical or physical trigger is applied. An example of this in nature is the formation of a double strand of DNA, the genetic material in every cell.

Source: <https://www.chemistryconnected.com/courses/CHM316/chemmatters-oct2009-nanotech.pdf>

Nanoparticle Melting Point Depression (Chloe Grant)

Nanoparticles are more susceptible to melting at lower temperatures than their bulk counterparts due to several factors related to their size, surface characteristics, and structural properties. I found this interesting because the lower melting point of nanoparticles can be utilized in nanomedicine through design to undergo phase transitions at specific

temperatures, enabling controlled drug release. One reason for the depressed melting point is their increased surface-to-volume ratio. At the nanoscale, a larger proportion of atoms are located at the surface of the particle, and these surface atoms are less tightly bound than those in the interior. This results in a higher surface energy, which can lower the energy required for the particle to melt. Structural defects, like dislocations, vacancies, and grain boundaries, are more prevalent in nanoparticles compared to bulk materials. These defects contribute to the lowering of the melting point by providing easier pathways for the crystal structure to destabilize.

Source: [Nanoparticles improve melting and solidification for manufacturing processes](#)

Nanotechnology in Vaccine Delivery (Sagar Bulsara)

Nanotechnology can enhance vaccine efficacy and safety, especially for diseases like HIV, malaria, and cancer. Nanoscale carriers – such as virus-like particles and liposomes – boost immune responses and allow for alternative, less invasive delivery methods like intranasal and oral vaccines. While these innovations show promise, challenges remain in ensuring safety, cost-effectiveness, and regulatory approval. Overall, nanotechnology could revolutionize vaccines, but thorough testing and validation are essential.

Source: [Nanotechnology in vaccine delivery](#)

The impact of Nanotechnology in fighting infections (Maia Tahir)

Nanoparticles (NPs) serve as vaccine vehicles and can enhance and combat drug resistance, avoid adverse reactions, and improve efficacy. NPs can also easily detect diseases and have already been used to detect Covid and E. Coli. Antibacterial and antiviral properties can be woven into everyday items needed to prevent disease like masks, and gloves with nanomaterials. This can help improve and stop the spread of infections worldwide and has shown promising results in much of the testing.

Source: [Nanotechnology's frontier in combatting infectious and inflammatory diseases: prevention and treatment](#)

Application of Nanotechnology in Veterinary Medicine (Kimberly Silva)

Nanoparticles can directly deliver drugs to specific target cells, enhancing therapeutic effectiveness, reducing side effects and minimizing drug residues. The use of nanoscale materials and drug delivery forms are effective in the dysgenesis, treatment and prevention of both infectious and non-infectious animal diseases. Examples of nano emulsion vaccines are influenza vaccine and recombinant B. anthracis vaccine.

Source: <https://www.mdpi.com/1999-4923/15/9/2326#:~:text=Those%20innovative%20approaches%20have%20demonstrated,legal%20aspects%20is%20also%20provided.>

Nanotechnology in Cosmetics: Dermatology and Skin Care Products (Awais Hameed, et al.)

Nanotechnology has been used in the cosmetic industry for the past couple of years. It has transformed skincare by increasing the effectiveness and deliverance of different active ingredients into the skin. Nanoparticles have a variety of benefits, including increased penetration since the particles are so miniscule, and nanoparticles allow for more skin specific treatment options. These are just a few of the ways nanotechnology has been implemented into the skincare industry.

Source: https://www.researchgate.net/profile/Fazal-Ur-Rehman-6/publication/331452854_Scope_of_Nanotechnology_in_Cosmetics_Dermatology_and_Skin_Care_Products/links/5c797038299bf1268d309204/Scope-of-Nanotechnology-in-Cosmetics-Dermatology-and-Skin-Care-Products.pdf

Nanostructured Epoxy Adhesives (Emma Duran)

These adhesives are able to exhibit increased mechanical strength, chemical resistance, thermal resistance, and more. Epoxy adhesives are versatile and powerful bonds that contain resin and a hardener to allow them to have increased durability and allow different materials to stick to one another. With all these wonderful properties they are able to adhere to all types of surfaces like woods, glass, and ceramics. Nanostructured adhesives are crucial to many different industries today as they are used in automotive manufacturing, aerospace engineering, and even the electronics industry. Of course, just like most other topics, nanostructured adhesive are under further research each day to increase durability and minimize waste products.

Source: <https://nanografi.com/blog/nanostructured-epoxy-adhesives/#:~:text=Nanostructured%20epoxy%20adhesives%20exhibit%20remarkable,on%20uneven%20or%20rough%20surfaces.>

Nanotechnology Use in Animals (Tiarra Phillips)

Nanotechnology has helped with treating diseases, diagnosing, tissue engineering, vaccine production and much more within veterinary medicine. It has also helped in their health, production, breeding and reproduction and nutrition. In the article I found it states that Nanozinc oxide has been used to increase development rate, immunity and reproductive performance. Overall, it helps with the husbandry of many animals and supports their health in ways that some traditional medications cannot help with.

Source: <https://www.frontiersin.org/journals/genetics/articles/10.3389/fgene.2022.915911/full>

Nanotechnology Combatting Antibiotic Resistance (Isabella Su)

Antibiotic resistance is an imminent threat to public health, and researchers are working hard to understand and solve this issue. A promising path towards fighting antibiotic resistance is the use of nanoparticles. Nanoparticles have the potential to conduct antimicrobial activity, such as growth inhibition, or acting as antibiotic carriers or killing agents. Nanomaterials, such as silver ions (Ag⁺), have been shown to simultaneously cause DNA damage while binding to the bacterial cell membrane and causing the cell to leak its contents, ultimately killing the microorganism.

Source: <https://pmc.ncbi.nlm.nih.gov/articles/PMC6340759/>
<https://www.sciencedirect.com/science/article/abs/pii/S0065216407000044>

Nanotechnology Dimension Market Research (Josue Mendez-Tapia)

The importance and application of nanotechnology is becoming more prominent. It is also expanding into more areas people's daily lives. Nanotechnology is a process manipulating materials at the nanoscale, which exhibit unique properties in contrast to the larger counterparts. Nanotechnology is finding itself into healthcare, electronics, and renewable energy just to name a few. The nanotechnology market is projected to grow by a large scale. It is currently at 5.3 billion and is expected to reach 74.9 billion by 2033.

Source: https://finance.yahoo.com/news/nanotechnology-market-expected-reach-revenue-170500635.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlMmNvbS8&guce_referrer_sig=AQAAAAp5wSn6EmU5vQrZX4_KkaqO8RRi5f_PY0qAlVtQNoj6RiDFcxTtnNyST_uliwWN7QGYuD8OCdNx3dnw7aqPfxsmJ5cl2E8CcUeEr48UKEN5GfXmDmsfjaA86cB7AXEEOZxepHMB1XPblLg1W-hwesAl1kSo4cNp8eFQsidH3GS

Risks and Benefits of Nanotechnology in Engineering (Chad Chu)

Nanotechnology is something that has been growing in popularity in the past decade and longer. The integration of nanotech into engineering is not something unknown and has already happened. For instance, the creation of smaller and faster transistors for computers has been the driving force in the computer industry. The formation of such parts is formed with ultrafine abrasive particle mixtures including nanoparticles. These overall benefit the industry with greater efficiency and advancement with their technological devices. However, there are also risks with nanoparticle toxicity in daily life depending on the particle sizes which indicates more toxicity with the finer-sized particle. Additionally, they can be further broken down based on nanomaterial classes such as metals, metal oxides, carbons, etc. Therefore, we need to consider both the risks and benefits that come with nanotechnology in our daily lives.

Source: <https://pmc.ncbi.nlm.nih.gov/articles/PMC2844666/>

Food Nanotechnology – Kristen Tang

More recent research shows the practical use of nanotechnology in the food industry, specifically with bacteria detection and quality control. At its core, nanotechnology has many versatile uses. Its versatility stems from the microscopic nature of its tools that allows its users to view, identify, and interact with tiny tiny molecules. According to the Pubchem article titled Food Nanotechnology published in 2010, many good ingredients have naturally nano sized components that contribute to food structure and tastes. Nanobiosensors and nanovehicles can be utilized to detect, monitor and control these micro substances which could help restructure food products in many different ways. Milk for example is rich in proteins and fats and once a nano device enters, these molecules may be disassembled or reassembled which can then produce different milk products that could be more homogenized or more yogurty texture. By altering certain structures on a transcriptome level, Nanotechnology can be used abundantly in all sorts of natural ingredients.

<https://pmc.ncbi.nlm.nih.gov/articles/PMC3781769/#:~:text=Nanotechnology%20applications%20in%20the%20food,by%20increasing%20the%20barrier%20properties.>

Neuro-nanotechnology (Victoria Muela)

In recent years, neuroscientists have used new and developing nanotechnology. This is being used as an innovation that is best suited to the biological targets, allowing the nanostructures to expand prostheses and neural interfaces. Nanotechnology is also being used by neuroscientists as a way to develop imaging instruments that would allow further studying of neural tissue processes. The nanotechnology used has allowed for better diagnostic techniques, delivery of medicines, helping small chemicals cross the blood brain barrier, and help utilize compounds for neural regeneration and neuroprotection. The incorporation of nanotechnology into physiology / cellular biology / medicine has allowed for tailoring of molecular interactions.

Source: <https://pmc.ncbi.nlm.nih.gov/articles/PMC9809121/>

Applications of Carbon Nanotubes- Hannah Haddad

An interesting thing I've learned about carbon nanotubes is how strong and lightweight they are. They were discovered by accident in 1991 and are made from a tiny rolled-up sheet of carbon. Even though they are very small, they are stronger than steel, but they are light and flexible. Due to their structure, they conduct electricity very well. Because it conducts electricity very well it becomes useful in electronics, batteries, and even medical devices.

Difficulties in Nanoparticles and Drug Delivery (Emma Engel)

One of the main difficulties in the utilization of Nanoparticles as effective therapeutics are drug delivery and biodistribution. These can be affected by many factors including the shape and size of the nanoparticles, such as rod and sphere. And, in many cases, the physical and biological barriers of the body change under the influence of disease. Therefore, Nanoparticles are difficult to engineer as broad therapeutics.

Source: <https://www.nature.com/articles/s41573-020-0090-8#Sec7>

Carbon Nanotubes: Structure, Properties, and Applications (Derek Curry)

Carbon is a highly useful atom to use for production. Particularly graphene which can be produced artificially for sturdy and structurally sound constructs and creations. This can be done on an extremely small scale in many different shapes, ranging from single-walled nanotubes to multi-layered nano graphite structure sheets. Graphene is very modifiable, allowing it to be shaped circular or layered out in a plane, both remain strong and resilient against external forces. As stated in the source, the most impactful properties of these carbon nanotubes is their conductive and anti-static properties, strength and flexibility, and their adhesive effects. While none of these effects are new, the important part is now applications which previously used graphene can be downscaled to a nano-level.

Source: <https://tuball.com/articles/single-walled-carbon-nanotubes>

Engineered nanoparticles in ocean fertilization for atmospheric carbon dioxide removal (Kenton Chao)

Artificial ocean fertilization is a technique that adds nutrients to the upper ocean to help stimulate phytoplankton growth in order to remove carbon dioxide from the atmosphere. However, its efficiency is still lower than natural ocean fertilization because of the small available amounts of nutrients and its low export rates of biomass to the deep ocean. However, ENPs, or engineered nanoparticles, can be utilized to enhance phytoplankton growth to a degree that are less likely to harm marine ecosystems. These nanoparticles can be used to increase the lifetime and boost carbon export on phytoplankton to overcome the limiting factors of current artificial ocean fertilization. One way that ENPs can help phytoplankton lifetimes and increase artificial ocean fertilization efficiency is by making ENPs repel grazers and competitors to phytoplankton by changing the doses of various ENPs that are utilized like Copper and Gold nanoparticles.

Source: <https://www.nature.com/articles/s41565-022-01226-w>

Nanotechnology Application in Environmental Remediation (Natalie Verdugo)

Nanotechnology has had a large impact in many fields. A topic that caught my interest with nanotechnology is the impact nanotechnology can have in helping the environment. With nanotechnology energy efficiency can be reached as well as the detection and cleanup of environmental contaminants. With the creation of nanotechnology-enabled

sensors, these sensors can detect chemical and biological agents in the air and soil and allow us to measure and analyze the harmful chemicals and biological agents present. In addition to this, a nano fabric “paper towel” was developed for oil cleanups. This nano fabric paper towel allows for the cleanup of at least 20 times more oil. Lastly, I would like to highlight that nanoparticles are also used in the process to clean industrial water pollutants and treat impurities of water at a lower cost. Nanotechnology has had amazing applications in the cleanup of the environment, and I hope nanotechnology can be continued to be used to improve the current state of the world.

Source: <https://www.nano.gov/about-nanotechnology/applications-nanotechnology>

Possible Application of Nanotechnology in Food Science (Martin Aranjó Jr.)

Nano technology has different applications from drug delivery systems to electronics, one aspect where upcoming nanotechnology has begun to flourish is the utilization of nanotechnology in food science. The Journal Applications of Nanotechnology in Food Science: Perception and Overview, gives us an insight of how nanotechnology has begun the transformation in food science, and food packaging to include nanotechnology. The article focuses on how food processing like the utilization of nano additives can improve nutrition on our food to improving gelatin agents to improve texture, and even a focus on nano capsulation to protect flavor and aroma in food. Some other focuses this article focuses on is how Food packaging can make packaging antimicrobial and utilize nano-biosensors to detect if pathogens or spoilage of the food is present, most importantly the improvement of packaging with the utilization of nanoparticles to keep food lasting longer and tasting the same as it was freshly prepared. Currently, as this is a developing technology the article does explain some safety issues at the moment, with the risk that nano counterparts that are not part of the intended nano particle can affect body organs and tissues. As research progresses and more exploration of this topic continues to grow it seems that the future of food packaging and food safety will improve.

Source: <https://www.frontiersin.org/journals/microbiology/articles/10.3389/fmicb.2017.01501/full>

What are nanoparticles in sunscreen? (Andrea Alvaro)

When choosing your natural sunscreen, you have two options; those with nanoparticles and those without. The difference between the two will show up on your skin. Both titanium dioxide and zinc oxide are approved by the FDA as natural suncreening ingredients. They each give broad-spectrum UV protection, although titanium dioxide works best when combined with zinc oxide or another synthetic sunscreen ingredient. Zinc oxide and titanium dioxide work by reflecting UV rays away from the skin, shielding the skin from the sun. In their regular, non-nano sized form, zinc oxide and titanium dioxide are quite white. When incorporated into sunscreen, they'll leave an obvious opaque white film across the skin. Enter nanoparticles. Sunscreen made with micronized zinc oxide and titanium dioxide rub into the skin much better and won't leave behind a pasty look. The ultra-fine nanoparticles make the sunscreen less opaque but just as effective.

Source: <https://www.verywellhealth.com/what-are-nanoparticles-in-sunscreen-4138307>

“What Are Nanoparticles in Sunscreen?” *Verywell Health*, <https://www.verywellhealth.com/what-are-nanoparticles-in-sunscreen-4138307>. Accessed 14 Nov. 2024.

Targeted Therapeutic Nanotechnology in Cancer (Darren Kao)

In many cancers PD-L1 protein can be found binding cancer cells and inhibiting immune cell activity. PD-L1 disrupts immune cells by creating a physical “shield” blocking binding sites on the cell surface and releasing signals for immune cells to ignore the cancer. Recently scientists have developed a small protein, “Affibody”, that is able to bind to PD-L1 on

the cancer cell surface. The Affibody/PD-L1 complex can help carry cancer fighting drugs directly to cancer cells. Currently, scientists are working on optimizing how the Affibody binds to PD-L1 to form a stronger Affibody/PD-L1 complex that will be able to survive in the body longer and prolong the benefits provided by the complex. Affibodies are also being tested to directly deliver doses of radiation to tumors which will target cancer cells, killing them overtime, and minimize the damage by radiation to normal cells. Beyond drug delivery, Affibodies are also being investigated for surgical uses. By tagging Affibodies with dyes, they can target PD-L1 on cancer cells and help surgeons locate tumors by marking them with the dye.

Source: <https://phys.org/news/2024-11-scientists-stable-protein-complexes-cancer.html>

What is a Carbon Nanotube? (Anahi Gonzalez)

The carbon nanotube is considered to be a nano-allotropes meaning that it has unique properties, in which it can be applied to different fields. Its structure consists of overlapping cylinders as its structure which can give its name to like a double-walled carbon nanotube. Due to its uncommon C-C bond and cylindrical structure it gives the structure a good amount of strength. This nanotube has also been shown that its mirror image impacts various kinds of properties like electronic, optical, and mechanical. Another fact I learned is that it can be synthesized by catalytic chemical vapor deposition, laser ablation, sol-gel, and arc discharge.

Source: [https://www.sciencedirect.com/topics/materials-science/carbon-nanotube#:~:text=Carbon%20nanotubes%20\(CNTs\)%20are%20a,Nanocomposites%20for%20Industrial%20Applications%2C%202021](https://www.sciencedirect.com/topics/materials-science/carbon-nanotube#:~:text=Carbon%20nanotubes%20(CNTs)%20are%20a,Nanocomposites%20for%20Industrial%20Applications%2C%202021)

Tetrazine Carbon Nanotubes for Pretargeted In Vivo “Click to release” Bioorthogonal Tumor Imaging (Angel Martinez):

The article I found talks about targeted approach in cancer therapy and imaging using nanotech. SWCNTs and Bioorthogonal chemistry are used for precise activation of drugs/imaging probs. Bioortho chemistry which is the inverse of Diels Alder, allows rapid selective chemical reactions in living organisms without interfering with biological functions, this reaction is called "click to release". SWCNTs are used because of their loading capacity and ability to target tumors through EPR effects. Overall, this article shows how there is promising advancement in targeted cancer therapies and imaging tech.

Source: https://csu-cpp.primo.exlibrisgroup.com/permalink/01CAL5_PUP/1f8h3e0/cdi_wiley_primary_10_1002_anie_202008012_ANIE202008012

Nanotechnology Applications in Daily Life (Esbai Rabadan)

https://nanografi.com/blog/nanotechnology-applications-in-daily-life/?srsltid=AfmBOoqzdHAS7BygJvF9OKmjbT-VWU_4cv4_gI2F62Sn9Yi9GFmBcJkH

This article explained the many ways that nanotechnology has been used in our daily lives. I learned about the impact of nanotechnology that has been implemented in various industries including food, electronics, and medicine. The most interesting fact that I learned about was the example of how nanoparticles have unique properties because of their high surface area-to-volume ratio. Gold was used as a reference, the particles are about 5-10 nanometers in size and this causes there to be an immense decrease in melting temperature (by hundreds of degrees), compared to a larger piece of gold. This proves how these particles can be used in more ways and have a lot of potential because of their properties making them more reactive. This opens up new possibilities of use and can transform industries at an atomic level.

Application of Some Nanoparticles in the Field of Veterinary Medicine (Ashley Ramirez)

<https://pmc.ncbi.nlm.nih.gov/articles/PMC6968591/#:~:text=Nanoparticles%20in%20the%20field%20of%20pharmacology%20are%20considered%20an%20ideal,the%20target%20tissues%20and%20organs.>

In this article, the authors explain the many problems that could be solved by using nanotechnology in the veterinary field. As well as explaining the many methods in which nanoparticles can be used, and the different nano-systems available. Due to the minimal size, the development of antimicrobials in nanoparticle systems is considered an excellent alternative delivery system for the treatment of microbial diseases by increasing therapeutic effect and overcoming side effects. Not only will pets benefit from being ensured they are receiving the medications, but their owners will have a better sense of relief knowing that they are doing their best to improve their pet's health.

Cancer & Nanotech: Treatment & Therapy (Jack Flaherty)

In recent years, nanotechnology has been rapidly progressing, and has been applied to various fields, one of the most prominent being the medicinal field. One example of this is seen in the application of nanotechnology in cancer treatments; in an effort to reduce the negative side effects of chemotherapy, which come from the treatment targeting non-cancerous cells, nanosized carriers are conjugated or encapsulated with chemotherapeutic agents and directed only towards cancerous cells. This allows the treatment to be more selective and have less negative side effects.

Source: <https://www.cancer.gov/nano/cancer-nanotechnology/treatment>

Malik S, Muhammad K, Waheed Y. Emerging Applications of Nanotechnology in Healthcare and Medicine. *Molecules*. 2023 Sep 14;28(18):6624. doi: 10.3390/molecules28186624. PMID: 37764400; PMCID: PMC10536529

(Michelle Navarro)

Scientists are advancing the use of nanotechnology in medicine to improve diagnostics, treatments, and preventive care, as well as to develop the next generation medical tools. This review brings together diverse applications of nanomedicine, highlighting recent advancements in areas such as regenerative medicine, gene therapy, oncology, and drug delivery. Strong collaboration among healthcare professionals, researchers, and technologists is essential for continued progress in the field. The review also emphasizes the need to address potential health, environmental, and ethical concerns associated with nanotechnology to ensure its responsible use in healthcare.

A new avenue for plant genetic editing, Nanotechnology (Tristan Steelman)

Genetics has always been exciting for being a central point of various fields contributing to the success of new innovations. Plant genetic editing has remained fairly stagnant from techniques developed nearly a decade ago being utilized such a *Agrobacterium*-mediated transformation which its already simple application leading to half of all crops in the United States being genetically modified or edited using this mainstream method or similar methods. Nanotechnology has promising potential applications with precise editing of genes in plants and even more promisingly limitless applications to various plant species that were not before possible to genetically modify i.e. plants that could not be infected by the *Agrobacterium*. The precise nature of nano sized particles can make the already difficult to use tungsten gene guns have a more realistic counterpart of inserting nanotech that would essentially function the same way leading to precise editing of plant genomes or plant immune systems. This would provide new avenues to deal with a population crisis again and future food shortages once again like genetically modified organisms did in the past.

<https://www.frontiersin.org/journals/plant-science/articles/10.3389/fpls.2021.663849/full>

Nanotechnology for Fertilizer Enhancement (Kirsten Sanchez)

The article highlights how nanotechnology could transform nitrogen-based fertilizer efficiency. Currently, these kinds of fertilizers lose their nutrient content to environmental factors such as soil and air. With nanotechnology, nitrogen-based fertilizers could be engineered to release nutrients when plants can absorb them, thus improving nitrogen use efficiency and reducing waste. Nano fertilizers can be made in various forms including nutrient-encapsulated particles, coated compounds, or nanoscale emulsions. Early research showed promising potential benefits like crop yields and improved plant resilience, but progress is slow because of funding and regulatory issues, undermining needed support to use nanotechnology's potential in sustainable agriculture.

<https://www.nature.com/articles/nnano.2010.2>

Nanotubes for Spinal Cord Injury Regeneration (Faith Olumofin)

Nanotubes are carbon-based materials that are made of a graphene sheet rolled into a cylinder with a diameter of the order of nanometer. Some characteristics of nanotubes include flexibility, strength, durability and electrical conductivity. Their chemical and mechanical properties allow nanotubes to be implanted in spinal cord tissue.

<https://www.sciencedirect.com/science/article/abs/pii/B9780081028070000089>

Applications of nanotechnology for immunology (Cindy Estrada)

In this article it explains that the engineering of different nanoparticles can result in new vaccines to be created. This includes virus-like particles made of nanoparticles which activate the innate immune system. This increases the up regulation of chemokines that are significant in T-cell activation such as CD40. VLPS tended to be more effective in enhancing antigen uptake in comparison to microparticles. This technology, however, has its limitations due to a lack of research on humans, but it remains promising. Another way nanotechnology can be used to inhibit the immune response which is especially significant in detrimental responses such as autoimmunity. Nanoparticles can be used to inhibit inflammatory cytokines such as IL-2. Decreasing the effects that autoimmunity may cause. This is through the size of nanoparticles. Nanoparticles may also play a significant role in passive immunity, delivering antibodies for specific pathogens.

<https://www.nature.com/articles/nri3488#Sec4>

Nanotube Technology and the Noninvasive Treatment of Alzheimer's Disease (Kyle Nehk)

The article discusses the potential uses of nanotube technology for the treatment and mitigation of Alzheimer's disease. The authors propose using nanoscintillators to selectively target amino acids for oxidation in a key Alzheimer's disease linked molecule. This process works by utilizing x-rays in conjunction with the nanoscintillators to create a highly reactive single oxygen. This single oxygen then carefully chooses a specific amino acid in A β monomers to oxidize which prevents the congregation of these monomers around neurons. When combined with increasingly common early testing for Alzheimer's disease, this potential treatment can work to mitigate symptoms before they appear and impact a patient's life.

<https://onlinelibrary.wiley.com/doi/full/10.1002/adhm.202301527>

The Application of Nanotubes in Pharmacy and Medicine (Johanna De Castro)

This article highlights the significance that carbon nanotubes play and why they are used in pharmacy and medicine. They proved to be excellent for drug delivery in the body without metabolism. It has also been used for tissue regeneration, biosensor diagnosis, enantiomer separation of chiral drugs, extraction and analysis of drugs and pollutants. More specifically in drug delivery, the drug is fixed inside the carbon nanotubes and is introduced in the body via oral or injection or directly into the site using a magnetic conjugate. The cells will inject the capsule and the nanotube will spill the drug into the cell and deliver the drug.

<https://pmc.ncbi.nlm.nih.gov/articles/PMC3806157/>

Goo for knee cartilage (Ariella Scott)

With the help of nanotechnology, scientists create a material that can help regenerate cartilage in knees. The material is comprised of nanoscale fibers and has a rubbery, goo like consistency which mimics the natural environment of cartilage. There have been tests on animals, in which the material led to significant cartilage regeneration within six months. It also began producing new tissue that contains collagen, this is essential for pain-free joint function.

<https://news.northwestern.edu/stories/2024/august/new-biomaterial-regrows-damaged-cartilage-in-joints/>

Application of Carbon Nanotube in Field Emission (Brandon Catalano)

Tunneling through electrons caused by metal tipping into a vacuum when a strong electric field is applied is known as field emission. A strong local electric field causes the carbon nanotube to have a very high aspect ratio. In addition, they have a low relative work function, meaning that electrons can be released with little energy. Because of their strength, CNTs can be used to create battery materials that facilitate cycles of charging and discharging, thereby prolonging battery life.

<https://www.cas.org/resources/cas-insights/batteries-drug-delivery-emerging-applications-carbon-nanotubes>

Nanotechnology Applications in Veterinary Medicine (Maverick Millon)

The veterinary field is always on a constant grind to expand and develop. The most recent studies are showing how nanotechnology can be used in diagnostics, treatment, and preventative care. For example, nanoparticles can be implemented to deliver medicine or attack very specific cells (like cancerous cells). Studies are also beginning to show how vaccines with nanotechnology can be more effective than today's conventional vaccines. Overall, this is a huge step in humanity and should not be one that we take a step back in.

<https://www.frontiersin.org/journals/genetics/articles/10.3389/fgene.2022.915911/full>

Carbon Nanotubes and Their Applications in Satellites (Dylan Risolia)

One of the fields that is always looking to utilize the newest and greatest technologies are those related to spacecraft creation, delivery, and satellite technologies. This is especially true with satellites, which are now using carbon nanotubes in a multitude of ways. One such way is in antennas, as the special properties of nanotubes allow a 20x increase in performance when compared to standard materials. This is just one of a multitude of uses that nanotubes have shown within spacecraft, and many such technologies are still being studied and developed.

<https://ui.adsabs.harvard.edu/abs/2018cosp...42E2725P/abstract>

Nanotechnology in animal production

Nanotechnology has possible applications in animal production through nutrient delivery and reducing the need for antibiotic treatments. Through nanotechnology nutrients that may have a hard time being transported through food due to being hydrophobic are shown to have better absorption when coated in nanotechnology. This added nutrition has helped animals such as poultry to grow more full than those without supplements, this also makes production animals more feed efficient. Nanotechnologies have also been developed to target gram negative bacteria, creating a toxin that reduced the growth and possibility of infection by bacteria.

Hill, E. K., & Li, J. (2017). Current and future prospects for nanotechnology in animal production. *Journal of animal science and biotechnology*, 8, 1-13.

Delivery anywhere with Nanoparticles, (Toranosuke Kato)

Using nanoparticles it is possible to mimic or alter the biological process of humans to diagnose and treat certain diseases. Specifically, it is possible to control the delivery and release of drugs, proteins, nucleic acids, or peptide delivery using various systems like Nanocapsules or Nanospheres. Both function as a delivery system to disperse the specific drug into the targeted area most efficiently. The body has various defence mechanisms to protect itself as well as biological barriers but nanoparticles can be formulated to bypass these barriers to deliver the necessary drugs. With Diseases like cancer where a tumor can form in hard-to-reach areas, the use of nanoparticles to treat these tumors has shown promising results, and can expect more applications for this type of treatment in the future.

Singh R, Lillard JW Jr. Nanoparticle-based targeted drug delivery. *Exp Mol Pathol*. 2009 Jun;86(3):215-23. doi: 10.1016/j.yexmp.2008.12.004. Epub 2009 Jan 7. PMID: 19186176; PMCID: PMC3249419.

[https://pmc.ncbi.nlm.nih.gov/articles/PMC3249419/#:~:text=Nano%20delivery%20systems%20hold%20great,barriers%20\(e.g.%2C%20BBB\)](https://pmc.ncbi.nlm.nih.gov/articles/PMC3249419/#:~:text=Nano%20delivery%20systems%20hold%20great,barriers%20(e.g.%2C%20BBB))

Stimuli-responsive Mesoporous silica nanoparticles used in cancer therapy (Dylan Luu)

Mesoporous silica nanoparticles (MSN) and their usage as drug delivery vehicles with the ability to release them on command. The drug or cargo is trapped in the pores of MSN and is released using molecular "nano valves" that respond to various stimuli such as light, pH, and enzymes. The importance of MSNs is their ability to address the problem of premature drug release and drug instability as they offer a new efficient method capable of advanced controlled release technology that enhances treatment precision by targeting specific cells while minimizing side effects. An example of MSN effectiveness can be seen in ovarian cancer treatment as the nanoparticles incorporate anti-fouling properties to improve drug delivery. This is done by reducing protein adsorption and lowering the immune response towards the nanoparticle. This results in enhanced targeted drug delivery to cancer cells with reduced side effects towards the ovaries. The main benefit of MSN compared to traditional drug delivery

devices or treatment is the unique structure allows for high drug loading capacity and controlled release thus improving the therapeutic effectiveness for ovarian cancer.

Zhu Y, Bai Y, He J, Qiu X. Advances in the stimuli-responsive mesoporous silica nanoparticles as drug delivery system nanotechnology for controlled release and cancer therapy. 3 Biotech. 2023 Aug;13(8):274. doi: 10.1007/s13205-023-03651-7. Epub 2023 Jul 12. PMID: 37457870; PMCID: PMC10338408.

Nanotechnology Advances in the Detection and Treatment of Lymphoid Malignancies (Randy Hernandez)

Lymphoid Malignancies are a very prevalent and serious set of complex diseases that have a multitude of treatment methods. This research sets themselves out to distinguish different diagnostic and treatment therapies using Nanoparticles (NP), and change the way we view precise methods of patients receiving their desired treatments and/or diagnosis. The methods listed in the research cover a very broad range of assistance to understanding Lymphoid Malignancies, from the different nanoparticle compositions to the different applications they may have, ranging from imaging processes to biological care.

Adamo, Francesco Maria et al. "Nanotechnology Advances in the Detection and Treatment of Lymphoid Malignancies." International journal of molecular sciences vol. 25,17 9253. 26 Aug. 2024, doi:10.3390/ijms25179253

<https://pubmed.ncbi.nlm.nih.gov/39273202/>

Nanotechnology and drug delivery (Soroush Azizi)

Explores the application of nanotechnology to improve drug delivery systems, particularly through the development of nanopatforms. These systems aim to enhance the precision, effectiveness, and safety of drugs, targeting diseased tissues while minimizing harmful side effects. The key molecule discussed in this volume is the drug-loaded nanoparticle, which plays a central role in enabling controlled release and targeted delivery. Various materials used in these nanoparticulate systems, including polymers, lipids, and cyclodextrins, are reviewed for their potential in drug delivery applications

[https://csu-cpp.primo.exlibrisgroup.com/permalink/01CAL\\$ PUP/cjlkpp/alma991074822512902901](https://csu-cpp.primo.exlibrisgroup.com/permalink/01CAL$ PUP/cjlkpp/alma991074822512902901)

Fullerene or "Buckyball" and Free Radicals (Abby Yuen)

Fullerenes, more commonly known as "Buckyballs" are nanoscale 60-carbon molecules that are shaped like a soccer ball. Each carbon is bonded with two other carbons, and due to the spherical shape of the molecule, the atoms undergo angle strain. They readily bind to free radicals, which are highly reactive molecules that can cause inflammation and damage or kill cells. Fullerene has been demonstrated to be able to neutralize these free radicals, however, in high doses, fullerene has been shown to induce toxicity in vivo. In vitro, tests have shown that fullerenes are able to induce lysis of erythrocytes (red blood cells), and lipid peroxidation, an oxidative chain reaction in which one lipid molecule becomes oxidized to form a lipid peroxide, damaging the membrane.

<https://link.springer.com/article/10.1007/s00204-012-0972-6>

New Nanoprobe to boost non-invasive-cancer treatment (Kaitlyn Gomez)

Researchers at AIBN have developed a new nanotechnology to improve photothermal therapy (PTT), an encouraging non-invasive cancer treatment that uses near-infrared light to destroy the cancer cells. They developed a ratiometric photoacoustic probe that can monitor inflammation and reactive oxygen species like hypochlorous acid during PTT, addressing a key challenge factor in the

therapy's efficacy. This probe allows instantaneous detection of cancer and inflammation and potentially reducing a tumor resurfacing or metastasis of the cancer. This discovery enhances PTT by providing precise inflammation control which can be a promising tool for more effective and localized cancer treatments.

<https://aibn.uq.edu.au/article/2024/11/new-nanoprobe-boost-non-invasive-cancer-treatment>

Nanotechnology Used for Cancer (Crystal Nguyen)

Cancer has been a worldwide disease that has caused death in over 9.6 million people. Nanotechnology has promised to improve cancer care and patient outcomes through its ability to target specific cells as well as reduce side effects. CellSearch system was one of the first FDA-approved diagnostic tests that had magnetic nanoparticles that help identify tumor cells. Nanotechnology is always growing especially in its usage for cancer.

[Cancer nanotechnology: current status and perspectives - PubMed](#)

Nano-Drug Delivery (Katie Gardella)

Drug delivery is how a drug or pharmacologically active agent is transported to the target cell to treat a health issue. Conventional routes of drug delivery have certain limitations, while the use of a nanocarrier can aid in the targeted and sustained delivery of drugs. These nanocarriers are composed of liposomes, dendrimers, and carbon nanotubes. Researchers are using this nanotechnology to focus on factors such as drug delivery systems for future viruses, gender-sensitive delivery systems, affordability, greener drug delivery systems, and systems to resolve unmet clinical needs.

<https://www.sciencedirect.com/science/article/pii/S259009862200015X>

Nanoparticulate systems for dental drug delivery (Tyler Zwagerman)

Nanotechnology offers transformative potential in dental drug delivery through the development of nanoparticulate systems. These systems enable targeted delivery of therapeutic agents, improving efficacy while minimizing side effects. By utilizing nanoparticles, treatments can achieve sustained release, enhanced bioavailability, and better penetration into tissues, addressing various health challenges with precision. These new nanotechnologies that are emerging allow for a new way of approaching treatments, while being less invasive than other treatments.

<https://www.sciencedirect.com/science/article/abs/pii/B978008102985500022X>

Nanotube X-Rays (Marin Aiko-Powell)

A new nanotube-based imaging system could take sharper, faster pictures that trump today's X-rays and CT scans. In a traditional X-ray machine, a filament emits electrons when it is heated above a certain threshold, and those electrons fly through the body and hit a metal electrode on the other side, creating images; CT scans produce three-dimensional images by rotating the electron source. However, using an array of carbon nanotubes that emit hundreds of electrons simultaneously as soon as voltage is applied to them is faster than a regular X-ray machine because there are no filaments to warm up, and the multiple nanotube emitters can also take pictures from many different angles without moving.

<https://www.discovermagazine.com/the-sciences/9-ways-carbon-nanotubes-just-might-rock-the-world>

Nanohydrogels and their potential (Bryan Engleman)

Nanohydrogels have become popular in recent times as their possible applications have been spreading widely. The two different types of nanohydrogels that are currently being experimented with are natural and synthetic. Both of these have their own possibilities and applications. The synthetic kind can be used for gene therapy, biosensing, as well as being used as a delivery system for various products. Natural nanohydrogels can be used for cancer therapy, agriculture, as well as tissue engineering. If these hydrogels were to improve, there could produce serious leaps for society.

<https://pmc.ncbi.nlm.nih.gov/articles/PMC8875080/>

Integrating Nanotechnology into Cancer Care (Monse Solis)

The article "Integrating Nanotechnology into Cancer Care" discusses the progress and obstacles in applying nanotechnology for cancer diagnosis, imaging, and treatment. It focuses on new developments in nanoparticle drug delivery systems, including FDA-approved options like Doxil and Abraxane, which enhance drug stability, bioavailability, and targeting of tumors while minimizing side effects. The characteristics of nanoparticles, such as their size, shape, and surface features, play a crucial role in how well they circulate, penetrate tumors, and interact with the tumor environment. The article also looks at innovative nanoparticle designs, like nanometal-organic frameworks and "protocells," which merge therapeutic and imaging functions, pushing forward theranostic applications.

<https://pubs-acs-org.proxy.library.cpp.edu/doi/10.1021/acsnano.9b04266>

Cancer nanomedicine: a review of nano-therapeutics and challenges ahead (Aiden Daniels)

To begin, the development and impact of nanomedicine on cancer and cancer therapy is still an ongoing field with research and funding growing. In chemotherapy there has been an increasing adaptation of nanomedicine because targeted delivery with less toxicity and higher bioavailability leads to better results. Furthermore, different nanoparticle systems, including liposomes and polymeric micelles, are considered, together with FDA-approved systems and current research in other areas like thermal nanomaterials and extracellular vesicles.

<https://pubs.rsc.org/en/content/articlehtml/2023/ra/d2ra07863e>

The Future of wireless nanotube applications in gas detection (Alexis Herrera)

The article, "Carbon Nanotube Based Microwave Resonator Gas Sensors" describes the use of nano tubing which has a special property in its ability to have a sensitive sensor to detect very small amounts of gas in the air. From the team of the project, they found that 4000Hz/ppm was the sensitivity. They used ammonia in order to gauge their sensitivity and was dependent on the transfer of electrons from the ammonia gas into the nanotube sensors. This is very important research that has large amounts of significance for future research in nanotube sensors which can help better observe and monitor industrial process and monitor the environment at a more sensitive level which can ensure a more knowledgeable foresight of any environmental changes or a more sensitive monitoring in any process that rely on sensors.

<https://ebookcentral.proquest.com/lib/csupomona/reader.action?docID=312303>

Nanotubes (KJ Von Borstel)

Scientists from all over the world are eager to use these rolled up sheets of carbon, nanotubes, to help better the world. These flexible carbon chains can be made in to tubes, which are proving to be the world's next greatest invention. They bring such desirable qualities like super strength, electrical and heat conductivity, and what is even better is that they are also VERY small and light weight. These nanotubes can open the door to much greater inventions like new types of body armor, ways to implement new cancer treatments and can even benefit the use of hydrogen cars! These nanotubes can be used in a broad spectrum of ways and that is not just why scientist, but science lovers from all over the world are excited to see what these little, but powerful single atom sheets will do for our world!

<https://www.discovermagazine.com/the-sciences/9-ways-carbon-nanotubes-just-might-rock-the-world>

Nano-technology in Drug Delivery

Nano based drug delivery has allowed major scientific advance in regards to treating certain diseases. This type of technology involves the nano medicine to be biocompatible with certain polymers, including chitosan and alginate, to disperse the drug to its desired location. Although some disadvantages are still not conclusive such as long-term effects and the amount of time it takes to reach toxicity.

<https://jnanobiotechnology.biomedcentral.com/counter/pdf/10.1186/s12951-018-0392-8.pdf>

Nanotechnology's involvement with the ecosystem and wildlife (Marilyn Gutierrez-Hernandez)

Nanotechnology has crucial involvement in the animal industry through veterinary medicine, improvement of animal nutrition and environment conservation. Something interesting that I found in this article is their involvement in aquatic organisms to help treat water pollution. There is an unfortunate toxic impact on the aquatic organisms from the nanomaterials but they have been trying different alternatives to diminish the toxicity in their environment where most of the alternatives include the use of metal nanoparticles. More specifically, their best alternative included the use of carbon dot-TiO₂ nanocomposites to be able to use sunlight to break down the pollutants into water. They were able to kill different fish pathogens such as streptococcus iniae which can affect both fish and humans if ingested. This emphasizes the importance of the need to break down pollutants in water because it doesn't just affect the wildlife, but humans as well.

<https://www.mdpi.com/1999-4923/15/9/2326>

The Impact of Carbon Nanotubes in Nuclear Medicine (Isabella Gonzalez)

It has recently been discovered that carbon nanotubes (CNTs) have the potential to transport radionuclides to malignant tumor cells as a form of radiotherapy. Despite this possible breakthrough, it is imperative to consider the water insolubility of pure CNTs, which poses a major risk of toxicity against living cells. In vitro testing has demonstrated that these purified CNTs are in fact toxic to human cells. Studies with modified, water-soluble CNTs, including in vivo testing in mice, yield more favorable results. Mice that were administered the altered CNTs did not exhibit major signs of toxicity. However, these studies remain in their early stages, and extensive testing and an extended period of observation of the mice are required before furthering research in humans.

<https://jnm.snmjournals.org/content/48/7/1039.short>

Nanotechnology and Nano-propolis in animal health (Hermelinda Sendin)

Nano-propolis and other nano-structures can be used as growth promoters in animals and antibacterials in medicine. Nano-propolis is a dark yellowish brown adhesive collected from bees when mixing their wax with parts of plants. Nano-propolis is easier to enter the outer membrane of bacteria and activate antibacterial compounds within the bacterial cell wall. These along with other nanotechnology can be used to create nano-anti microbial for veterinary medicine such as health, performance, and reliable food production.

Tatli Seven, P., Seven, I., Gul Baykalir, B., Iflazoglu Mutlu, S., & Salem, A. Z. M. (2018).

Nanotechnology and nano-propolis in animal production and health: an overview. *Italian Journal of Animal Science*, 17(4), 921–930. <https://doi.org/10.1080/1828051X.2018.1448726>

Nanotechnology and psychobiotics in Schizophrenia treatments (Devienne Ramos)

The brain-gut connection has brought certain psychiatric disorders into a new light. Schizophrenic patients treated with psychobiotics experience a decrease in symptoms. Nanotechnology offers a promising future for delivery methods of prebiotics, probiotics and synbiotics. Since the gastrointestinal tract is such a hostile environment, survival and efficacy of the administered treatment is enhanced by nanoparticles and nanostructured materials.

<https://www.mdpi.com/2075-4426/14/4/391#B17-jpm-14-00391>

Single-walled carbon nanotubes: structure, properties, applications, and health & safety (Wendy Pham)

Carbon atoms are able to bond many different ways which result in different forms with different properties, one of them being nanotubes. Carbon nanotubes have single-walled carbon nanotubes (SWCNT) and multiwalled carbon nanotubes (MWCNT). SWCNT contains one graphene layer while MWCNT consists of multiple layers of SWCNT which turns into a concentric arrangement. Three methods of nanotube synthesis is plasma arc discharge, laser evaporation, and chemical vapor deposition. SWCNT are very useful in reinforced plastics, industrial coatings, car tires, electrochemical power sources, improving strength in rubber composites, and structural materials.

<https://tuball.com/articles/single-walled-carbon-nanotubes>

Nano-technology in Herbal Medicine (Kendall Almazan)

Herbal medicine has been widely used across the globe for years, due to its effectiveness in treating various diseases with minimal side effects, and its ability to enhance bioavailability. However, several problems such as, low oral absorption and poor solubility limit their use. In order to overcome this, nanoparticles can play a vital role by showing potential utilization to deliver herbal medicines with better therapy. Nanoparticles can enhance herbal medicine delivery by targeting specific organs, improving effectiveness and safety, and reducing the frequent dose. Nanotechnology involves manipulating materials at the atomic scale, typically within the 100 nm range, where unique properties emerge, offering surprising and beneficial results. Nanoparticles also reduce the toxicity in medicine while still providing therapeutic effects. Nanosized herbal medicines have the potential to enhance biological activity and address the limitations of pure herbal drugs.

K. Chakraborty, A. Shivakumar, S. Ramachandran. Nanotechnology in herbal medicines: A review.

[Nanotechnology-libre.pdf](#)