Potential Nanotech in Vaccines

David Fergusson

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Contents

Introduction

This document describes the various elements of nano technology applicable to intra body networks as reported in the scientific literature. It details the current state of development in each area and then attempts to identify evidence of the technology's presence in the Covid vaccines via a number of studies that have been performed by various groups and individuals as listed in the appendix.

There appears to be clear evidence of Carbon Nanotubes and Carbon Nanofiber octopuses present in the vaccines, along with various actuators such as colloidal beads, microbubbles and hydrogel based swimmers. Also there is some evidence of self assembly processes.

Carbon Nanotubes (CNT)

Carbon is the most versatile element in the periodic table, owing to the large number of bonds of different types.
There are 3 naturally occurring allotropes of carbon, diamond, amorphous carbon and graphite. Additional allotropes are derived from synthetic processes such as graphene (rediscovered 2004), graphene nanoribbons (GNR), carbon nanotubes (CNT discovered 1991) and fullerenes (discovered 1985). Carbon nanotubes can be created using a folded graphene nanoribbon.

Graphene cannot be used for field-effect transistors operating at room temperature because it is a semi-metal with a zero bandgap. Without sufficient bandgap a device cannot be switched off. Processing graphene sheets into nanoribbons with widths of less than 10nm can open up a bandgap that is large enough for room temperature transistor operation. These FETs have proved to be promising in biological and chemical sensing.

The properties of CNTs include high current capacity and high thermal conductivity and their mechanical strength is extremely high (100 times stronger than steel) and they also have a very high sensitivity. CNTs also possess high surface area, high elasticity, accompanied by ultra light weight and excellent chemical and thermal stability.

Owing to their high aspect ratio, they have the capacity to easily cross biological membranes and to be internalized by cells leading to the use of CNTs for drug delivery. Their 2D nature provides the ability to overcome the blood-brain barrier..

CNTs are water insoluble and cannot disperse uniformly in most aqueous media due to their hydrophobic structure. Their poor solubility and their potential toxicity have been discussed and partially alleviated in the past decade through the functionalization of the CNTs surface (fCNTs). They can be functionalized with different polymers or covalently decorated with other bioactive molecules to improve biocompatibility.

CNTs appear to be suitable for interaction with electrically active tissues, such as neuronal and cardiac due to their high electrical and thermal conductivity, which offers the potential to directly interact with functional neurons to detect and transmit signals. CNTs have the desirable properties required for use as electrodes for neuronal stimulation. The nanoscale roughness and porosity created by CNT materials offer a neuronal interface that can record fine neural signals.
CNTs display exceptional flexibility and mechanical resistance so they can be twisted and bent. When located in neuronal tissue, they can establish connections that bridge the neuronal synapse. This means that they link neurons with different shortcuts, shorter than natural axons.
Many studies have demonstrated that CNT substrates are able to sustain neuronal survival and to promote neuronal outgrowth and regeneration.

Toxicity studies have varied in their conclusions, with some reporting that CNTs are essentially benign and others that assert CNTs have marked toxic effects.
Determinants of CNTs toxicity are their size and surface functionalization together with the method and dose of administration.
Many studies showed that CNTs can induce inflammation, fibrosis, angio-genesis and cytotoxicity to macrophages dependent upon the CNTs length, iron content or crystal structure.
Pulmonary exposure and ingestion represent a primary vector. Many studies focus on genotoxicity, the potential of CNTs to induce DNA damage and mutation.

Timeline of Papers

2000	Mattson,MP | Haddon,RC | Rao,AM	Carbon nanotubes are strong, flexible, conduct electrical current, and can be functionalized with different molecules and used as probes of neuronal function at the nanometer scale.
2005	Gabay,T | Jakobs,E | Ben-Jacob,E | Hanein,Y	Engineered self-organization of neural networks using carbon nanotube substrate.
2005	Lovat,V | Pantarotto,D | Lagostena,L | Cacciari,B | Grandolfo,M | Righi,M | Ballerini,L	Carbon nanotube substrates boost neuronal electrical signalling.
2006	Gheith,MK | Pappas,TC | Liopo,AV | Sinani,VA | Shim,BS | Motamedi,M | Kotov,NA	SWNTs electrically stimulate excitable neuronal cells.

2006	Wang,K | Fishman,HA | Dai,H | Harris,JS	Neural stimulation with a carbon nanotube microelectrode array.
2008	Demoustier,S | Minoux,E | LeBaillif,M | Charles,M | Ziaei,A	Review of two applications of carbon nanotubes: nano-antennas and nano- switches.
2010	Lee,W | Parpura,V	Carbon nanotubes as electrical interfaces with neurons.
2011	Voge,CM | Stegemann,JP	Review of Carbon nanotubes in neural interface applications.
2015	Vitale,F | Summerson,SR | Aazhang,B | Kemere,C | Pasquali,M	Neural stimulation and recording with bidirectional, soft carbon nanotube fiber microelectrodes.
2015	Kafa,H | Wang,JTW | Rubio,N | Venner,K | Anderson,G | Pach,E | Al-Jamal,KT	Ability off functionalized MWNTs to cross the in vitro blood–brain barrier and to accumulate in an in vivo mouse brain.
2015	Shityakov,S | Salvador,E | Pastorin,G | Fšrster,C	Targeted drug delivery CNT across the blood–brain barrier to the central nervous system.
2019	Rauti,R,Musto,M,Bosi,S,Prato,M, Ballerini,L	Properties and behaviour of carbon nanomaterials when interacting with neuronal cells.

Found in studies

- Dr Campra [2] found CNTs in Moderna, Pfizer. *(02_001.jpg, 02_002.jpg, 02_009.jpg, 02_012.jpg, 02_013.jpg, 02_014.jpg)*
- Dr John B [6] found in his Pfizer images including a CNT which appears to be incubating. *(06_001.jpeg, 06_004.jpeg)*
- Dr Carrie Madej [4] reported CNTs in the Moderna. (*04_002.jpg, 04_003.jpg)*
- Reutlingen Austrian study [9] found CNTs in the Pfizer and in blood. *(09_007.png, 09_008.png)*
- Dr. Martín Monteverde [18] found CNTs in the Sputnik and AstraZeneca. *(18_003.png, 18_004.png)*
- Dr Young [1] *(01_001.png, 01_002.png, 01_003.png)*, German Researchers [5] *(05_002.png)*, Dr Axel Bollant [8] *(08_005.png, 08_006.png)* and Dr Zandre Botha [11] *(11_004.png)* found possible CNTs in the blood of vaccinated individuals.

Carbon Nanofiber (CNF) octopus

Carbon nanofibers are characterized by being solid cylinders of carbon or graphene. They can grow as octopus like structures. The nanofibers that form the carbon octopus could be useful to create connections or contacts for capacitors. They could also be used as junctions for synapse connections.

Timeline of Papers

2006	Pham-Huu,C | Vieira,R | Louis,B | Carvalho,A | Amadou,J | Dintzer,T | Ledoux,MJ	Octopus-like growth mechanism of carbon nanofibers over graphite supported nickel catalyst.
2014	Saavedra,MS	Carbon nano-octopuses: growth and characterization - *Carbon Nano Fibre growth could be achieved with adhesive tape*.

Found in studies

- Dr Frank Zalewski [10] reported an octopus type structure in the Pfizer which came in the form of an egg which when in contact with graphite tape began to sprout a head and legs over the course of 4 days. The most rapid growth of the filaments occurred when the sample was introduced into "a sputtering chamber, where the temperature is high, so that the graphene is pulverized, the electric arc burns" although these are not conditions found in the human body. *(10_001.png)*
- Ricardo Delgado [17] shows an image of an octopus type structure in the Pfizer. *(17_001.png)*
- Dr Carrie Madej [4] reported an octopus type structure in the Moderna. *(04_001.png, 04_004.jpg)*

Graphene Quantom Dots (GQD)

Graphene Quantom Dots are small particles whose properties are defined by the effect of Quantum Hall. They amplify electromagnetic signals and with it emission distance, especially in environments such as the human body enabling them to function as wireless transceivers. The semiconducting properties of GQDs allow them to form a network through which they can monitor and effectively neuromodulate as nanotransducers.
GQDs are variable and many properties including the degree of surface oxidation, surface charge density, doping status, or links with polymers can be dramatically different, yielding different interaction behaviours with biomolecules. They can be created through the degradation of graphene oxide sheets.

GQDs can acquire various morphologies, for example hexagonal, triangular, circular or irregular polygon. They are able to penetrate cells membranes.
GQDs emit fluorescence with blue and green photo luminescence and so are used in drug delivery, biosensing and imaging.

Many studies have shown that GQDs have excellent bio-compatibility and low cytotoxicity but others have shown them to have high cytotoxicity.

Found in studies

- [12] Graphene Quantum Dots found in the blood of a vaccinated individual. The GQD are not necessarily from a vaccine as they are used in bioimaging and drug delivery.

Quantum Dot Cellular Automata (QCA)

In 1993, Craig Lent proposed a new concept, QCA, as a nano analogue of conventional CMOS circuits. CMOS circuits require a range of voltages or currents applied to transistors to have logical values, whereas QCA technology is based on the position of the electrons in cells.
Processing of information in QCA circuits occurs without flow of electrons resulting in

considerable less power consumption and heat generation than in CMOS circuits.

A QCA cell consists of four GQDs in a square array coupled by tunnel barriers. Two electrons are injected into the cell which are free to tunnel between adjacent dots. Due to Coulombic repulsion, the two electrons reside in diagonally located dots representing two polarizations.
The polarization of each cell is influenced by neighbouring cells. Tunnelling to the outside of the cell is not allowed due to a high potential barrier. QCA cell-based circuits can be built in a 3D form to allow greater complexity in a small area.

When the QCA cells are combined, cables and circuits are created, where inverters, crossovers and logic gates are created enabling the production of transistors, processors, transceivers, multiplexers, demultiplexers and consequently of any router.

A wire can be built by placing several QCA cells in a row. When the polarization state of the first cell of the array changes, subsequent cells assume the same polarization state due to the Coulomb interaction effect, enabling the information transmission through the wire without electric current flow.

To develop a nanorouter requires cable crossings (which form logic gates), demultiplexers and parallel-to-serial converters. Demultiplexers are devices capable of receiving a signal at the input QCA and sending it to one of several output lines which allows the signal to be routed for further processing. The parallel-to-series converter is a circuit capable of taking several sets of data as input, transporting them through different QCA cables and transmitting them at different moments of time through the output cables.

Clock zones control the transmission of the signals through the circuit. In each zone of cells a single potential can modulate the barriers between the dots which controls the tunnelling barriers within a cell, thus controlling when a cell might or might not be polarized. Clock zones permit a cluster of QCA cells to perform an operation, have its states frozen and then have its outputs used as inputs propagated to the next clock zone cluster. With the use of the superconducter graphene very high processing speeds can be achieved.

Conventional logic circuits use AND, OR, NOT gates as the fundamental gates. The fundamental logical gates in QCA are majority voter and inverter gates, since any other logical component may be implemented from them i.e. full adders, multiplexers and memory cells. The majority voter is only composed of five cells, three input cells, one output cell, and a centre cell, which is the decision making cell. From the majority voter gate other logical gates can be deduced such as AND/OR gates.

Developments :

- In 2015 The design of a Nanorouter implemented by QCA was presented.
- Frost et al. proposed a new QCA memory architecture, called H-Memory, made of many small spirals, each containing a word and arranged in a recursive structure. This memory is a realization of a complete binary tree, where each leaf contains a memory cell and each node has a routing circuit.
- Walus et al. presented a layout of a conventional Random Access Memory architecture using QCA.

- Line-Based parallel memory was proposed later for QCA implementation.
- The same group has proposed a new serial memory architecture for QCA, using basic building blocks known as tiles.
- In 2018 memory circuits have been proposed using QCA. Reversible full adder/subtractor and multiplier have been designed and a decoder circuit has been developed.

One of the most important unsolved problems in nanotechnology is how to make electrical contact from nano devices to microscopic electronic devices.

Timeline of Papers

2003	Kummamuru,RK | Orlov,AO | Ramasubramaniam,R | Lent,CS | Bernstein,GH | Snider,GL	Operation of a quantum-dot cellular automata (QCA) latch and shift register.
2005	Hu,W | Sarveswaran,K | Lieberman,M | Bernstein,GH	High resolution electron beam lithography and DNA nanopatterns for QCA.
2007	Huang,J | Momenzadeh,M | Lombardi,F	Sequential Circuit Using QCA - inverter and majority gate designs, latch, flipflop, bit counter, bit shift register.
2008	Xia,Y | Qiu,K	Design and application of universal logic gate based on QCA.
2011	Wang,ZF | Liu,F	Graphene quantum dots as building blocks for QCA. A simple design of the GQD-QCA majority gate (NOR and NAND).
2013	Sardinha,LH | Costa,AM | Net,OPV | Vieira,LF | Vieira,MA	NanoRouter: a QCA design - crossbar, demux and parallel-to-serial converter.
2015	Mohammadyan,S | Angizi,S | Navi,K	New fully single layer QCA full-adder cell based on a feedback model.
2015	Sardinha,LH | Silva,DS | Vieira,MA | Vieira,LF | Neto,OPV	TCAM / CAM-QCA: (ternary) content addressable memory using QCA used by routers and switches.
2017	Das,B | Das,JC | Fromd | Paul,AK	Nano-Router Design for Nano-Communication in Single Layer QCA - 4 input ports through a DEMUX and output to 4 receiver ports.
2018	Laajimi,R | Niu,M	Design of 2-input Exclusive-NOR (XNOR)/Exclusive-OR (XOR) gates with 3-input Exclusive-NOR (XNOR) gates which are composed of 10 cells.
2020	Sadeghi,M | Navi,K | Dolatshahi,M	New efficient full adder and full subtracter designs in QCA.
2021	Huang,J | Xie,G | Kuang,R | Deng,F | Zhang,Y	QCA-based Hamming code circuit for nano communication networks.

Found in studies

Although some studies show apparent candidates for QCA hosting chips, the great majority are likely to be salt crystals. However there are some artefacts which require investigation as they are not a good fit for the morphology of crystallised saline.

- A potential host chip for QCA logic gates was perhaps first scene in an anonymous German study of the Pfizer. *(19_001.png)*

- Reutlingen Austrian study [9] showed images of rectangular objects. *(09_001.png, 09_002.png, 09_003.png)*
- Dr Axel Bollant [8] showed an image of a strange regular shaped object moving in the Pfizer. *(08_002.png)*
- Dr Andreas Noack [13] video shows large number of rectangular objects. *(13_001.png)*

Antennas

The wave propagation velocity in CNTs and graphene nanoribbons can be up to one hundred times less than the speed of light meaning that the resonant frequency of nano-antennas based on graphene are up to two orders of magnitude lower than that of metallic nano-antennas.
Each hexagonal cell of the graphene lattice consists of 6 carbon atoms, with 6 de-localised electrons, 3 of which lie below the plane of the graphene and 3 above the plane. This creates an electron cloud of highly mobile repelling electrons forming an electron fluid which can support plasmon waves, known as the Surface Plasmon Polariton (SPP). If this fluid is pumped by an external source such as a parallel oscillating electric field it creates an electromagnetic wave which is emitted from the surface of the graphene at the lower end of the THz frequency spectrum.

A requirement for nano antennas is simultaneous wireless information and power transfer (SWIPT). Since EM waves carry not only information but also energy, antennas capable of converting an EM signal into a direct current using a ultra-high-speed rectifying diode are required.

Rectifying antennas, or rectennas, based on carbon nanotube arrays have been proposed since the discovery of the unique antenna capabilities of CNTs in 2004.
In 2015, Cola et al. provided the first demonstration of optical rectification, accomplished using a forest of vertically aligned CNTs, which act as nanoscale antennas with excellent absorption properties. Insulator–metal (IM) tunneling diodes fabricated on top of the array are ultra fast rectifiers that generate a direct current.
The achievable energy conversion is approximately 85% efficient.

Graphene nanoribbon based nano-patch antennas and CNT based nano-dipole antennas around 1 µm long resonate in the band 0.1 - 10.0 THz.

Graphene Bowtie rectennas consist of two triangular sections. The thickness of the antenna is 100 nm, and a nano diode made of graphene located between the two triangular sections rectifies the AC flux to DC.

Plasmonic graphene nanoantennas with a geometric diode such as bow tie can also collect energy from the infrared spectrum which guarantees a constant flow of energy.
Bow tie nano-rectennas take only 6 milliseconds to charge a nano-capacitor rather than 6 minutes for a CNT array. A graphene nano-mesh could act as a capacitor.

Rectennas can operate in a matrix or array. The approximate power output of a single rectenna is 0.11 nW. More elements connected in series can increase the production of current and power.

Fractal antennas have wideband and multi-band capabilities. Fractal geometries can drive multiple resonances and the ability to make smaller and lighter antennas, with fewer components and radiative elements with less circuitry and higher gains.

Timeline of Papers

2002	Suh,YH | Chang,K	High-efficiency dual-frequency rectenna for 2.45 and 5.8 GHz wireless power transmission.
2007	NanfangY | Cubukcu,E | Angeluts,AA | Diehl,L | Bour,D | Corzine,S | Zhu,J | Capasso,F	Bowtie plasmonic quantum cascade laser antenna.
2008	Wang,Y | Wu,Q | Shi,W | He,X | Sun,X | Gui,T	Radiation properties of carbon nanotubes antenna at terahertz / infrared range.
2010	Kinzel,EC | Xu,X	Extraordinary infrared transmission through a periodic bowtie aperture array.
2013	Jornet,JM | Akyildiz,IF	Graphene-based plasmonic nano-antenna for terahertz band communication in nanonetworks Patent US 2016/0218434A1.
2014	Aldrigo,M | Dragoman,M	Graphene-based nano-rectenna in the far infra-red frequency band.
2015	Ahmadivand,A | Sinha,R | Pala,N Florida	Equilateral nanotriangles are able to support plasmon resonant modes in the range of visible to the near infrared region.
2015	Nafari,M | Jornet,JM	Metallic plasmonic nano-antenna for wireless optical communication in intra-body nanonetworks.
2015	Sharma,A | Singh,V | Bougher,TL | Cola,BA	Carbon nanotube optical rectenna.
2016	Bye,YFC | Chao,CTC | Rao,JY | Chiang,HP | Lim,CM | Lim,RC | Voo,NY	Tunable optical performances on an array of plasmonic bowtie nanoantennas with hollow cavities to accumulate optical energy in the hollow regions.
2017	Chen,Y | Chen,Y | Chu,J | Xu,XHefei	Bridged bowtie aperture antenna for producing an electromagnetic hot spot for enhanced and confined electric and magnetic near field.
2017	El-Araby,HA | Malhat,HA | Zainud-Deen,SH	Performance of nanoantenna-coupled geometric diode with infrared radiation.
2017	Khan,AA | Jayaswal,G | Gahaffar,FA | Shamim,A	Metal-insulator-metal (MIM) diodes with sub-nanometer surface roughness for energy-harvesting applications.
2017	Zainud-Deen,SH | Malhat,HA | El-Araby,HA	Energy harvesting enhancement of nanoantenna coupled to geometric diode.
2018	El-Araby,HA | Malhat,HA | Zainud-Deen,SH	Nanoantenna with geometric diode for energy harvesting.
2018	Rong,Z | Leeson,MS | Higgins,MD | Lu,Y	Body-centered nano-networks powered by nano-rectenna in the terahertz band.
2020	Boretti,A | Rosa,L | Blackledge,J | Castelletto,S	A Preliminary Study of a Graphene Fractal Sierpinski Antenna.
2021	Blackledge,JM | Boretti,A | Rosa,L | Castelletto,S	Fractal Graphene Patch Antennas and the THz Communications Revolution. *Example of a random fractal ‘tree’ antenna (p14).*

Found in studies

Although some studies show apparent candidates for Bow Tie antennas they correlate very closely with the morphology of salt crystals. Distinguishing them from salt crystals in the future may prove difficult. Similarly there are cases of dendritic fractal structures visible in some images which could possibly be related to fractal antennas but proving that they are indeed used as antenna is not feasible.

Self assembly

Traditional methods for fabricating micro-scale arrays are usually based on lithographic techniques. This approach has limitations as the size of device features become increasingly nano, so new approaches rely on the use of nano-scale templates made of synthetic or biological materials to leverage biology, with its inherent self-assembly capabilities. Bottom up fabrication exploits the intrinsic properties of atoms and molecules to direct their self-organization.

DNA origami is a technique that uses hundreds of short DNA oligonucleotides to fold a long single-stranded DNA molecule, which is called a scaffold strand, into various designer nano scale architectures. The DNA structures are 100 nm in diameter and approximate desired shapes such as squares, disks and five-pointed stars defined using a raster fill approach.
DNA's 3D double helix structure gives more advantages than other materials in guiding nanoparticles to 3D ordered assembly, not just 2D.
Small differences in the sequence of DNA base pairs and the ability to control DNA chain length and base sequence allows for a great deal of structural control and so it is possible to attach nanoparticles to specific locations on the surface of a DNA origami that looks like a featureless rectangle. For example a DNA scaffold molecule provides the address for the precise localisation of a semiconducting SWCNT field-effect transistor.
DNA origami has dramatically improved the complexity and scalability of nanostructures and with its high degree of customization and spatial addressability it provides a versatile platform with which to engineer nanoscale devices that can sense, compute, and actuate.

Teslaphoresis may lead to self-assembly in the presence of electric fields or the external reception of electromagnetic waves. Teslaphoresis utilizes the high voltage near-field AC radio frequency energy transmitted by a Tesla coil.

Timeline of Papers

1998	Esener,SC | Hartmann,DM | Heller,MJ | Cable,JM	DNA-assisted micro-assembly.
2002	McMillan,RA | Paavola,CD | Howard,J | Chan,SL | Zaluzec,NJ | Trent,JD	Quantum dots ordered into arrays defined by the lattice of the underlying protein crystal.
2003	Keren,K | Berman,RS | Buchstab,E | Sivan,U | Braun,E	DNA-Templated Carbon Nanotube Field-Effect Transistor. *Several SWNT-based devices have been successfully integrated into logic circuits and transistor arrays. However, the difficulty in precise localization and interconnection of nanotubes impedes further progress toward larger-scale*

		integrated circuits.
2006	Rothemund,PW	Scaffolded DNA origami - Folding DNA to create nanoscale shapes and patterns. assembling six different shapes, such as squares, triangles and five-pointed stars.
2008	Nykypanchuk,D | Maye,MM | Van-Der-Lelie,D | Gang,O	DNA-guided crystallization of colloidal nanoparticles - use DNA programmability to place nanoparticles in one and two dimensions.
2010	Gu,H | Chao,J | Xiao,SJ | Seeman,NC	A proximity-based programmable DNA nanoscale assembly line - DNA origami tile that provides a framework and track, DNA machines that serve as programmable cargo-donating devices, a DNA walker that can move on the track from device to device and collect and deposit cargo.
2016	Bornhoeft,LR | Castillo,AC | Smalley,PR | Kittrell,C | James,DK | Brinson,BE | Cherukuri,P	Teslaphoresis of carbon nanotubes.
2017	Hong,F | Zhang,F | Liu,Y | Yan,H	DNA origami: scaffolds for creating higher order structures.
2021	Sessler,CD | Huang,Z | Wang,X | Liu,J	In situ-synthesized nanomaterials - enable targeted synthesis of nanomaterials in the particular region of interest in the body.

Found in studies

Although some studies show apparent self assembly of chip like structures, the great majority if not all are likely to be merging salt crystals. However there are examples of apparent self assembly, particularly in chain like forms.

- Dr Carrie Madej [4] apparent Teslaphoresis in the Moderna. *(04_005.jpg)*
- Reutlingen Austrian study [9] showed self assembling chains in the AstraZeneca. Could they be in series power generators similar to piezoelectric arrays ? *(09_004.png, 09_005.png 09_006.png)*
- Dr. Martín Monteverde [18] found self assembly of what he referred to as microbubbles in the Sputnik and AstraZeneca and a ribbed structure in the AstraZeneca. *(18_001.png, 18_002.png, 18_004.png)*
- Dr John B [6] found a ribbed structure in his Pfizer. *(06_003.jpeg)*

Hydrogel

Andersen [20] looked at possible candidates for the 1450 cm-1 peak detected by Campra in his micro Raman study [3].

Polyvinyl Alcohol (PVA) hydrogel can serve as an ionic wire that transmits electrical stimuli. Graphene-based fibers and carbon nanotube structures can be covered by the PVA hydrogel which allows for the crossing of the blood-brain barrier and their introduction into brain tissue without being rejected.

Found in studies

- Campra [3] the 1450 cm-1 peak detected by Campra in his micro Raman study.

Nanodes - sensors and actuators

A generic nanosensor node includes an energy harvestor, a communication mechanism, some processing logic with nanomemory, and a module for sensing and actuation.
Nanodes include graphene quantum dots, swimmers and graphene nanoribbons.

The sensor is able to detect an optical, biological or mechanical event with high sensitivity and converts the response to an output electrical signal.
When a CNT or GNR is bent or deformed or when different types of molecules are absorbed on top of it, its electronic properties change. A CNT can be used to build a Field-Effect Transistor whose on/off threshold voltage depends on the CNTs physical properties such as shape and temperature or the presence of a specific type of molecule. The large surface area and the excellent electrical conductivity of graphene allows rapid electron transfer that facilitates accurate and selective detection of biomolecules. CNTs may have crystalline structures at one or both ends serving as electrodes.

The actuator responds to an input electrical signal to perform the administration of drugs or perform neuromodulation. GO and rGO are used for drug delivery as are GQDs.

2008	Liu,Z | Robinson,JT | Sun,X | Dai,H	PEGylated nanographene oxide for delivery of water-insoluble cancer drugs.
2009	Yang,X | Zhang,X | May | Huang,Y | Wang,Y | Chen,Y	Superparamagnetic graphene oxide nanoparticles for controlled targeted drug carriers.

Swimmers can be considered actuators.

Self-propelled colloidal nano-worms transport drugs to a target organ. With a flagellar body made up of magnetic beads where carbon nanotubes can serve as guides to create chains of colloid beads. Flexible swimmers have either flexible tails or joints or their entire body is bendable. Magnetic flexible swimmers can be propelled by means of oscillating or rotating magnetic fields, resulting is a swimming pattern similar to spermatozoa.

Micro structures fabricated in the form of bacterial or eukaryotic flagella can act as artificial microswimmers. For example, Trypanosoma Brucei exhibit a long slender form with a free flagellum. Micro organisms like Trypanosoma Brucei can adapt their shape and respond to their environment by exploiting the soft and stiff structures within their complex body plans.
Since these microswimmers are composed of thermally responsive hydrogels, their shape is sensitive to changes in ambient temperature.

Magnetic helical micro swimmers propel themselves in a corkscrew like motion.

Magnetic surface walkers move on a surface under rotating magnetic fields. They exhibit rolling or tumbling motions with or without contact with the surface. Swimmers can become surface walkers if they are actuated close to a surface.

Microbubbles with hexagonal links are sometimes PVA coated and can be made from CNTs. They aggregate from smaller bubbles and expand and contract and burst under the influence of frequencies. PVA is a conductor and can function as an electrode when coating a CNT. PVA microbubbles can be directed by magnetic fields and carry drugs for targeted delivery.

Timeline of Papers

2014	Tierno,P	Recent advances in anisotropic magnetic colloids: realization, assembly and applications.
2015	Fusco,S | Huang,HW | Peyer,KE | Peters,C | HŠberli,M | Ulbers,A | PanŽ,S	Shape-switching micro-robots for medical applications.
2016	Huang,HW | Sakar,MS | Petruska,AJ | PanŽ,S | Nelson,BJ	Soft micro-machines with programmable mobility and morphology incl Trypanosoma Brucei.

Found in studies

- Dr John B [6] found bead like objects in his Pfizer images including the semicircular structure. *(06_002.jpeg)*
- Dr John B [7] CNTs with Graphene Beads found in his Moderna images. *(07_001.jpeg, 07_002.jpeg)*
- Dr Zandre Botha [11] showed images of microbubbles from the J&J on the Stu Peters show. *(11_001.png, 11_002.png, 11_003.png)*
- Campra [14] images show microbubbles in AstraZeneca and Pfizer. *(14_012.png, 14_013.png)*
- Campra [2] magnetic beads on carbon nanotubes with amorphous or polycrystalline graphite in their terminations, and a possible flagellar bodied swimmer and possible microbubbles. *(02_003.jpg, 02_004.jpg, 02_005.jpg, 02_006.jpg, 02_007.jpg, 02_008.jpg, 02_010.jpg, 02_011.jpg)*
- German Researchers [5] *(05_001.png)* and Dr Axel Bollant [8] *(08_001.png)* found ribbon-shaped soft swimming nanorobots in the blood of vaccinated individuals.
- Dr Young [1] found an object resembling a Trypanosoma Cruzi. *(01_004.png, 01_005.png)*
- Dr. Martín Monteverde [18] found microbubbles in Sputnik and Pfizer. *(18_006.png, 18_007.png)*
- La Quinta Columna [16] discovered multiple red coloured CNTs in the Pfizer with a crystalline termination that then reacted to breath and not just air movement. *(16_001.png, 16_002.png, 16_003.png, 16_004.png)*

Mesoporous carbon spheres

Andersen [21] identifies these spherical objects as possibly mesoporous carbon spheres which have applications for drug delivery, supercapacitors, electrodes (which would be compatible with the properties of carbon nanotubes), electrochemical capacitor and even anodes for nano-batteries as well as EM absorption. The morphology is similar but not definitive.

Found in studies

- Campra [2] Spherical containers with unknown contents. *(02_018.jpg, 02_019.jpg, 02_020.jpg)*

Software-Defined Metamaterials (SDM)

Metamaterials are structures which enable powerful control of electromagnetic waves.
SDM enables smart Metamaterials which can change their electromagnetic behaviour at runtime utilising an embedded communication nanonetwork in their structure.
Each SDM controller interacts locally with its associated cells to adjust its properties and communicates with other cells to obtain or distribute the desired behaviour.
Currently a first wave of SDM designs is under development to showcase the capabilities of this new technology with the aim to deliver a proof of concept of the SDM paradigm.

2011	Jul | Geng,B | Horng,J | Girit,C | Martin,M | Hao,Z | Wang,F	Graphene plasmonics for tunable terahertz metamaterials by changing micro-ribbon width and in situ electrostatic doping.
2017	Abadal,S | Liaskos,C | Tsioliaridou,A | Ioannidis,S | Pitsillides,A | Solé-Pareta,J | Cabellos-Aparicio,A	Computing and communications for the software-defined metamaterial paradigm.

Nanonetworks

Nanonetworks are not just downscaled networks, there are several properties stemming from the nanoscale that require a total rethink regarding networking concepts.

Molecular nano-communication is one approach in which molecules are used to encode, transmit and receive information. Inspired by biology where cells employ molecular nano-communication to establish both intra-cellular and inter-cellular information links.

- Short range communication includes Calcium Ion signalling which is mostly used in inter-cell communication.
- Medium range communication includes flagellated bacteria carrying DNA coded with data.
- Long range communication includes pheromones which provides for molecular messages carrying information.

Neuronal networks can of course be used for molecular communication. Neurons have self-organizing ability which enables them to form a network.

Wireless communication networks using modulated carrier wave technologies require significant signal processing which nano networks cannot easily provide. Pulse modulation is more appropriate for nanorouter communications.
The 0.1-10 Terahertz band provides almost a 10 THz wide bandwidth window and can theoretically support very large bit-rates, up to several hundreds of Terabits per second.

The available transmission bandwidth increases with the antenna resonant frequency, but so does the propagation loss and molecular absorption.
The Terahertz channel is seriously affected by the presence of different molecules in the medium.

- Spreading loss refers to the expansion of the wave as it propagates through the medium leading to attenuation.
- Scattering loss is produced by different types of particles suspended in the environment, diffusion caused by particles or rough surfaces.
- Molecular absorption is the process by which part of the wave energy excites molecules found along its path as internal kinetic energy. The 0.1-10 THz band is also the resonance frequency of many molecules in the human body.

The effective communication distance for dense nano-networks inside the human body is restrained to about 1 mm. To cross the human skin barrier a frequency range of 0.1 - 4 THz is required.

The **physical network layer** defines the means of transmitting raw bits over a physical link connecting two nodes and is concerned with the modulation and symbol coding.
A proposed pulse modulation scheme is Rate Division Time Spread On-Off Keying (RD TS-OOK). A logical 1 is transmitted as a one-hundred-femtosecond long pulse and a logical 0 is encoded as silence.
To recognise symbols (silence or pulse), the inter symbol time is set to several hundred multiples of the symbol duration. Since the time between the transmission of two consecutive pulses is much longer than the pulse duration, several nano-devices can concurrently send sequence of pulses which are slightly time shifted without incurring collisions.
Three other carrier-less modulations have been proposed, Pulse Amplitude Modulation PAM, Pulse Position Modulation PPM and Binary Phase Shift Keying BPSK.

The **link layer** network protocols are used for channel access coordination, which is traditionally performed on the MAC sub-layer, and recovery from bit transmission errors usually performed on the Logical Link Control (LLC) sublayer. Medium Access Control (MAC) protocols are needed to regulate the access to the channel and to coordinate concurrent transmissions among nano-devices to reduce collisions.
The Terahertz band communication provides enormous bandwidth and significantly short transmission time, which leads to fewer collisions and interference than in traditional networks. However the high path loss and low energy of nano-devices coupled with noisy transmission media increase the probability of packet errors regardless of the huge bandwidth.
The majority of the currently proposed protocols only deal with the MAC sub-layer, with just the PHLAME and TCN protocols additionally proposing a LLC sub-layer mechanism for error correction and as such being concerned with communication reliability.
Energy consumption must also be considered including the time needed to harvest enough energy to retransmit a packet. Fully charged nanodevices are capable of transmitting just a few packets before energy depletion. Consequently, nanonodes are required to wait to recharge using energy harvesting

before being able to transmit again, which may introduce an unavoidable delay that renders packet retransmission useless. This requires energy harvesting aware MAC protocols where the selection of the next hop nanode is made on the basis of their available energy and current load. The most common method suggested for energy harvesting is to use the piezoelectric effect of zinc oxide (ZnO) collecting vibrational energy which can produce enough power for 1 packet transmission roughly every 10 seconds.
Additionally none of the link layer protocols explicitly accounts for the fact that nanonodes can be mobile.

The **network layer** handles routing operations. The limited processing and storage capabilities of nano devices dictate that routing design should not assume that nodes have knowledge of the network topology. The optimal routing strategy may not be easily employed because of its high computational requirement.
Design options must consider both centralised hierarchical cluster based architectures with nano controllers and distributed peer to peer architectures. There would be an expectation of a very high density of nano-devices in nanonetworks needed to overcome the limited sensing range of individual devices. Different types of nanosensors might be interleaved to detect different types of chemical compounds, which may result in thousands of nano-devices per square millimetre.
It is impractical to have individual network addresses for the high number of individual nanonodes so assigning addresses in a nanonetwork based on clusters or on a physical coordinate system is more practical. This makes it possible to address a group of nodes based on the health functionality they perform or the biological organ or phenomena they monitor. However such schemes assume that nanodes are generally static and are not moving in arteries for example.

Different applications will require different routing approaches. For example some might use multicast or broadcast flooding to clusters of nanodes while other routing methods are required for unicast to one receiver nanode. Communication between nodes can be either multi-hop or direct.

Different networks could be present in the same physical area leading to multi-user interference in uncoordinated nanonetworks which results in frequent channel errors.

Strict time synchronization among nano-nodes is a challenge in nano-networks.

To date designs considering network security have not been addressed.

All of the existing protocols have been evaluated either analytically or by means of software simulation. Their performance results are potentially not accurate, as they have not been derived with a very high level of realism or actual physical implementation.

Timeline of Papers

2008	Jornet,JM | Pierobon,M | Akyildiz,IF	Nanocommunication Networks.
2011	Balasubramaniam,S | Boyle,NT | Della-Chiesa,A | Walsh,F | Mardinoglu,A | Botvich,D | Prina-Mello,A	Development of artificial neuronal networks for molecular communication.
2011	Jornet,JM | Akyildiz,IF	Information capacity of pulse-based wireless nanosensor networks.
2012	Jornet,JM | Akyildiz,IF	Joint energy harvesting and communication analysis for

		perpetual wireless nanosensor networks in the terahertz band.
2012	Jornet,JM | Pujol,JC | Pareta,JS	PHLAME: A physical layer aware mac protocol for electromagnetic nanonetworks in the terahertz band.
2013	Wang,P | Jornet,JM | Malik,MA | Akkari,N | Akyildiz,IF	Energy and spectrum-aware MAC protocol for perpetual wireless nanosensor networks in the Terahertz band.
2014	Jornet,JM | Akyildiz,IF	Long femtosecond pulse-based modulation for terahertz band communication in nanonetworks.
2014	Mohrehkesh,S | Weigle,MC	Optimizing energy consumption in terahertz band nanonetworks.
2014	Pierobon,M | Jornet,JM | Akkari,N | Almasri,S | Akyildiz,IF	A routing framework for energy harvesting wireless nanosensor networks in the Terahertz Band.
2014	Suzuki,J | Boonma,P | Phan,DH	A service-oriented architecture for body area nanowires with neuron-based molecular communication.
2015	Ahmadzadeh,A | Noel,A | Burkovski,A | Schober,R	Amplification and forward relaying in two-hop diffusion-based molecular communication networks.
2015	Mohrehkesh,S | Weigle,MC | Das,SK	DRIH-MAC: A distributed receiver-initiated harvesting-aware MAC for nanonetworks.
2015	Tsioliaridou,A | Liaskos,C | Ioannidis,S | Pitsillides,A	CORONA: Coordinate and Routing system for Nanonetworks - anchor-points, nodes measure distances from anchors, sense of geolocation.
2015	Yao,XW | Wang,WL | Yang,SH	Joint parameter optimization for perpetual nanonetworks and maximum network capacity.
2015	Zarepour,E | Hassan,M | Chou,CT | Bayat,S	Performance analysis of carrier-less modulation schemes for wireless nanosensor networks.
2016	Tsioliaridou,A | Liaskos,C | Pachis,L | Ioannidis,S | Pitsillides,A	N3: Addressing and routing in 3d nanonetworks - node knowledge of its position in the network within a 3D space.
2016	Liaskos,C | Tsioliaridou,A | Ioannidis,S | Kantartzis,N | Pitsillides,A	Routing system for nanonetworks (DEROUS) selects nodes to serve as packet retransmitters/routers.
2018	Abbasi,NA | Lafci,D | Akan,OB	The first controlled information transfer through an in vivo nervous system of earthworms.
2018	Abd-El-atty,SM | Lizos,KA | Gharsseldien,ZM | Tolba,A | Makhadmeh,ZA	Molecular communications integrated with carbon nanotubes in neural sensor nanonetworks.
2018	Dhoutaut,D | Arrabal,T | Dedu,E	Bit Simulator, an electromagnetic nanonetworks simulator. *Given that research is impaired by the unavailability of ready to use hardware, simulation tools are needed to evaluate protocols and applications. Future work includes the enhancement of the physical model by taking into account the noise generated by an excited medium.*
2018	Vavouris,AK | Dervisi,FD | Papanikolaou,VK | Karagiannidis,GK	An energy efficient modulation scheme for body-centric nano-communications in the THz band. A combination of TS–OOK and PPM.
2018	Galal,A | Hesselbach,X	Nano-networks communication architecture: Modeling and functions. *However fully functional and efficacious*

		Nano-machines have not been fabricated to date, there are various solutions had been prototyped and tested.
2019	Wang,WL | Wang,CC | Yao,XW	Time Slot self-allocation based MAC (SSA-MAC) protocol for energy harvesting nano-networks - sender and receiver calculate the time slot from the node id.
2020	Bouchedjera,IA | Aliouat,Z | Louail,L	EECORONA: Energy Efficiency Coordinate and Routing System for Nanonetworks. Flood-based peer-to-peer routing scheme for static and dense 2D SDMs.
2020	Bouchedjera,IA | Louail,L | Aliouat,Z | Harous,S	DCCORONA: Distributed Cluster-based Coordinate and Routing System for Nanonetworks. Multi-hop point-to-point scheme for 2D dense SDMs.
2020	Fahim,H | Javaid,S | Li,W | Mabrouk,IB | Al-Hasan,M | Rasheed,MBB	An efficient routing scheme for intrabody nanonetworks using an artificial bee colony algorithm.
2020	Galal,A | Hesselbach,X	Probability-based path discovery protocol for electromagnetic nano-networks. *Micro/nano-gateways are smart hybrid devices that can communicate in both nano-scale and classical communication paradigms in micro/macro-communication networks. The fabrication of these gateways is still an open research area.*
2020	Yang,K | Bi,D | Deng,Y | Zhang,R | Rahman,MMU | Ali,NA | Alomainy,A	A comprehensive survey on hybrid communication in the context of molecular communication and terahertz communication for body-centric nanonetworks. *However the communication between the devices in such nanonetworks is still an open problem.*
2021	Oukhatar,A | Bakhouya,M | ElOuadghiri,D	Electromagnetic-Based Wireless Nano-Sensors Network: Architectures and Applications. *The development of a micro gateways device, which can connect the nano scale world to the micro scale world, and the management interface over standard networks, is still constantly an open research issue.*
2021	Lemic,F | Abadal,S | Tavernier,W | Stroobant,P | Colle,D | Alarcn,E | Famaey,J	Review on nanocommunication and terahertz networks: a top-down perspective. *Thus, special gateway nodes between the macro and nano worlds will be required, which has been only sporadically addressed in the literature to date.* *The latest IEEE P1906.1 recommendations lack recommendations about the interconnection between nanonetworks and existing communication networks.*

Other Anomalies

Structures that look organic start to emerge as samples of the AstraZeneca and J&J dry over time. According to Andersen [22] these are probably GO based hydrogels and CNTS or polymers such as PVA after they have dried out.

Found in studies

- Campra [2] Organic looking structures emerge in drying samples of AstraZeneca. *(02_021.png, 02_022.jpg)*
- Campra [2] Organic looking structures emerge in drying samples of J&J. *(02_023.jpg, 02_024.jpg, 02_025.jpg, 02_026.jpg, 02_027.jpg, 02_028.jpg, 02_029.jpg, 02_030.jpg, 02_031.jpg, 02_032.jpg)*
- Dr Axel Bollant [8] Organic looking structures emerge in drying samples of J&J. *(08_007.png)*
- Dr Zandre Botha [11] Organic looking structures emerge in drying samples of J&J. *(11_005.png, 11_006.png)*

Appendix of Studies

[1] Dr. Robert Young - Scanning & Transmission Electron Microscopy Reveals Graphene Oxide in CoV-19 Vaccines
https://www.drrobertyoung.com/post/transmission-electron-microscopy-reveals-graphene-oxide-in-cov-19-vaccines
https://www.docdroid.net/Ihq2YfO/informe-the-scientific-club-corregido-por-dr-campra-pdf

[2] Dr. Pablo Campra Madrid sent photographs of possible microbiota observed under electron microscopy to La Quinta Columna
https://www.orwell.city/2021/10/microbiota.html

[3] DETECTION OF GRAPHENE IN COVID19 VACCINES Dr Pablo Campra Universidad de Almería
https://www.researchgate.net/publication/355979001_DETECTION_OF_GRAPHENE_IN_COVID19_VACCINES

[4] Dr Carrie Madej reports on US Moderna study
https://everydayconcerned.net/2021/08/12/bombshell-news-american-medical-researchers-witness-self-assembling-graphene-oxide-nanotech-or-ai-syn-bio-in-moderna-vaccine-under-microscope/

[5] Vaccine & Blood Analysis Under Microscope Presented By Independent German Researchers, Lawyers & Doctor
https://www.bitchute.com/video/6M57qfcn5USY/

[6] Pfizer Vaccine Microscope Photos released By Dr John B, Scientist, lecturer
https://twitter.com/drjohnb2/status/1444639912880443396?lang=en-GB

[7] Bright field and phase contrast microscopy analysis of Moderna By Dr John B
https://twitter.com/DrJohnB2/status/1447639567658532873

[8] Pathological Institute Reutlingen, Germany presentation by Dr Axel Bollant
[9] Pathological Institute Reutlingen, Germany presentation by Austrian Group
https://www.bitchute.com/video/KgDSVTcrBCWF/

[10] Dr Franc Zalewski study of Pfizer
https://www.bitchute.com/video/Fpt5YUkEhZXp/

[11] Dr Zandre Botha on the Stu Peters show
https://odysee.com/@ZeeZ:1/StewPetersDrZandreBothaVaxxContents:7

[12] Graphene Quantum Dots found in the blood by Dr. Armin Koroknay
https://www.orwell.city/2021/12/GQD.html

[13] Dr Andreas Noack - Pfizer microscopy and the results of applying a magnetic field and UV light to a sample of the contents
https://153news.net/watch_video.php?v=5OX5YX7KW1MR

[14] Pedro Rosillo views images from Dr Campra
https://www.bitchute.com/video/c1KSTqhqKm1n/

[15] Pedro Rosillo views more images from Dr Campra
https://odysee.com/@Plandemia:2d/rosillo:0

[16] La Quinta Columna issues reports on microtechnology found in Pfizer vials
https://www.orwell.city/2022/01/lqc-report.html
https://odysee.com/@laquintacolumna:8/M%C3%81SIM%C3%81GENESDEPATRONESARTIFICIALESYMICROTECNOLOG%C3%8DAENLAVACUNAPFIZER:4
https://www.orwell.city/2022/01/complex-microtechnology.html
https://www.orwell.city/2022/01/self-assembly.html
https://www.orwell.city/2022/01/new-vial.html
https://www.orwell.city/2022/02/morgellons.html

[17] Ricardo Delgado of potential nanotechnology and CNF octopus in the Pfizer
https://www.orwell.city/2021/12/nanotechnology.html

[18] Dr. Martín Monteverde of Argentina carried out analyses of vials from Cansino, Pfizer, Sinopharm, AstraZeneca, and Sputnik.
https://www.orwell.city/2022/01/argentina.html

[19] Anonymous German study of the Pfizer
https://www.bitchute.com/video/JA6fvmQakTAS/

[20] The 1450 Raman spectrum in the coronavirus vaccine vials. A review of the scientific literature
https://cdn1.richplanet.net/pdf/0473.pdf

[21] Identification of patterns in coronavirus vaccines: Mesoporous spheres.
https://cdn1.richplanet.net/pdf/0469.pdf

[22] Identification of patterns in coronavirus vaccines: Cracks and wrinkles. Part 1
https://cdn1.richplanet.net/pdf/0475.pdf