
SCIENCE GALLERY COMICS GROUP
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MAGICAL MATERIALS
UNLEASH YOUR SUPERPOWERS!

“UNLEASH YOUR SUPER POWERS!”

INTRODUCTION BY MICHAEL JOHN GORMAN, DIRECTOR, SCIENCE GALLERY
& LYNN SCARFF, PROGRAMME MANAGER, SCIENCE GALLERY

What makes a material magical? Is it an ability to change shape before your eyes, to automatically heal, or to be one of the lightest yet strongest materials on earth? **MAGICAL MATERIALS** explores the properties of some of the world’s most mysterious materials, giving you an opportunity to investigate and experiment at the cutting edge of materials science.

In developing **MAGICAL MATERIALS**, Science Gallery teamed up with artist Stephen Byrne to create a band of superheroes imbued with the intriguing properties of the materials we are exploring. From *Nanoman*, with his amazing tensile strength and flexibility, to *Morph*, who can radically change shape or size due to a small variation in temperature, the **MAGICAL MATERIALS** superheroes exhibit physical and chemical properties that are directly based on emerging fields of materials science research.

Comic books regularly borrow from the world of science in both their plotlines and the creation of their superheroes, and materials science in particular forms the parameters of their superpowers. While characters such as *Batman* and *Iron Man* overtly use advances in science and technology as the basis of their power, others like *Wonder Woman*, with her mythical lasso of truth, are more inspired by scientific advancements—her creator, William Moulton Marston, also invented the polygraph. And now, with developments in nanoscience and high-end microscopy allowing us to manipulate the microstructures of matter to create materials with amazing capabilities, superpowers have never seemed more attainable. Inspired by the exhibition, you can sketch your own superhero in our design studio. Each week, we’ll be choosing a visitor’s superhero design for Stephen to bring to life as a full-colour comic book cover.

Superpowers, however, are not the only familiar comic book storyline. A public with sometimes mixed feelings towards new advances in science are another regular feature. In reality, we often embrace new technologies and the improvement they bring while also feeling anxious about the unknown consequences of synthetic materials. Like all good comic books, **MAGICAL MATERIALS** offers visitors opportunities to explore new materials and their applications, ask questions and imagine future scenarios.

We would like to thank the numerous researchers, artists, designers and producers that have been so generous with their time, ideas and connections in developing **MAGICAL MATERIALS**. In particular, our curators John Boland, Director of CRANN [Centre for Research on Adaptive Nanostructures and Nanodevices at Trinity College Dublin] and Marie O’Mahony [Advanced Fashion and Textiles, OCAD University, Toronto] who have contributed their expertise and knowledge to the exhibition.

Dig out your superhero cloak, unleash your superpowers and join us in exploring the peculiar properties of materials science!

INTRODUCTION BY JOHN BOLAND, DIRECTOR OF CRANN
[CENTRE FOR RESEARCH ON ADAPTIVE NANOSTRUCTURES AND NANODEVICES], TRINITY COLLEGE DUBLIN

Materials are the key ingredient in all technologies—from iPhones to flat panel TVs, and from medical implants to the controlled release of pharmaceutical drugs. Although materials shape the world we live in, the role of materials in underpinning vast sections of the Irish economy has largely gone unnoticed by the general public. Ireland is in fact one of the world leaders, and was independently ranked 6th for nanoscience and 8th for materials science, with the majority of these publications and discoveries coming from the CRANN Institute at Trinity College Dublin. **MAGICAL MATERIALS** highlights Ireland's scientific expertise in working with a range of nanoscale materials, from graphene to quantum dots and nanowires and how these materials are adding new functionality to existing electronics and medical devices, while introducing revolutionary new technologies. By understanding how these materials behave, we can begin to think about improving the efficiency of existing products, such as batteries, solar cells and computer chips. We can also work towards developing new exciting devices, from flexible electronic screens to personalised healthcare diagnostics and treatments. Advanced materials and nanoscience research taking place today is critical to Ireland's economic future.

"IRELAND IS IN FACT ONE OF THE WORLD LEADERS, AND WAS INDEPENDENTLY RANKED 6TH FOR NANOSCIENCE AND 8TH FOR MATERIALS SCIENCE"

INTRODUCTION BY MARIE O'MAHONY,
ADVANCED FASHION AND TEXTILES, OCAD UNIVERSITY, TORONTO

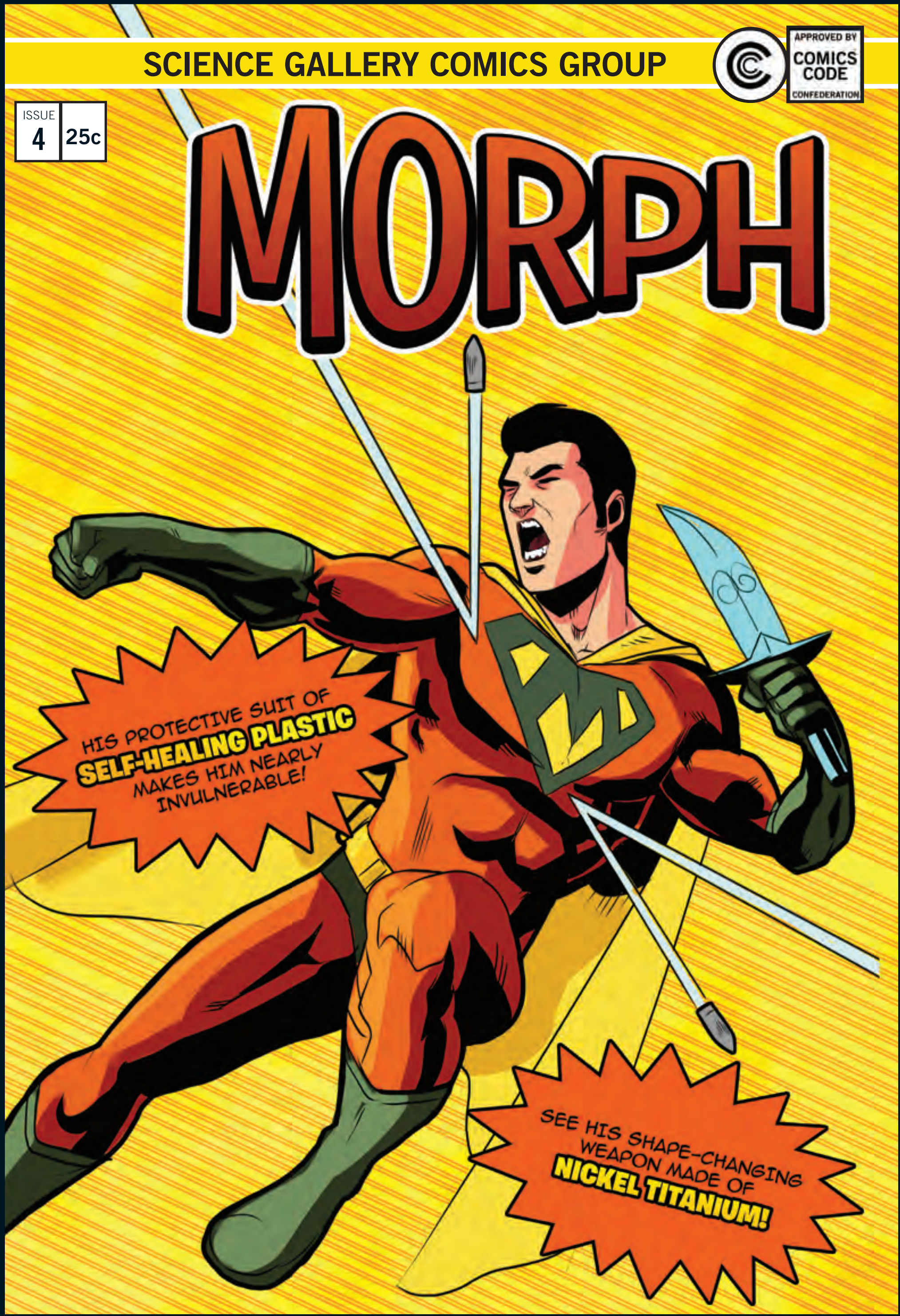
From mysterious to mythical, why do the properties of so many materials strike us as almost magical in nature? The Mayans believed that the gods originally tried to create humans from mud and wood. The Greeks described the Titan Prometheus as combining clay and water to make man, which in turn inspired Mary Shelley's book 'Frankenstein—The Modern Prometheus'. Today's myth-makers move with ease between science and science fiction. Self-healing phones, flexible screens and clothing designed to make the wearer stronger can and do exist in both fact and fiction, so the magic has become reality.

The relationship between science and science fiction has always been cyclical, as they inspire one another. In cinema Fritz Lang's work with Herman Oberth on the rocket design for *The Girl in the Moon* [1929] was considered so realistic that the rocket models were seized as state secrets by the Gestapo. When physicist Richard Feynman wrote his seminal article on nanotechnology *There's Plenty of Room at the Bottom* in 1959, scientists had little idea what materials made with such a revolutionary technology would actually look like, or what they could do. Science fiction writers and filmmakers were quick to step in with cult classics such as Richard Fleischer's *Fantastic Voyage* [1966]. Fleischer depicted a world where humans are shrunk to a nano-scale in order to be able to travel through a human body and perform surgery.

However, left to their own devices, early materials scientists were likely to try to recreate a synthetic version of what already existed in nature. Plastics are an example of this. It seems strange today that the material was once promoted as an alternative to ivory. For decades, plastic was dismissed as a cheap disposable material, an imitator of other more worthy materials, rather than one with qualities of its own worthy of consideration. However, with nanotechnology, the theory existed long before the technology to realise it. It is only relatively recently that the science has begun to catch up with scientific and science fiction vision. The benefit is that while plastic has struggled to find its own identity, nanotechnology is already being appreciated for its own unique characteristics. Although scientists have not attempted to resize people, they have gone on to develop some extraordinary materials and products such as carbon nanotubes and jeans that can clean pollution from the air. Science, it would seem, can sometimes be stranger than fiction.

Before modern science, the alchemists used evocative terms such as Quicksilver and Aqua Regina in their promises of turning base metal into gold. Today, the names of materials such as Aluminium Nitride and Quantum Dots invoke an other-world or super-power quality. Such titles hint at some of their inherent qualities, but tell little of their actual power, size or use. In **MAGICAL MATERIALS**, film and photography are used to reveal the secrets of some of these materials that are hidden from the naked eye. When Feynman first spoke of the potential of nanotechnology, he stressed the importance of photography in realising this vision, pleading "is there no way to make the electron microscope more powerful?". In the fifty years since then advances in microscopy and imaging have helped in our understanding, conceptualisation and in the development of new materials. In **MAGICAL MATERIALS** these techniques are seen to be employed not only by science, but by the hands of artists and designers who draw our attention to and beyond the science, to the inherent beauty of technology.

MAGICAL MATERIALS is a celebration of the wonder of our material world. The French philosopher Roland Barthes reminds us that of the senses "sight is the most magical", but also that "touch is the most demystifying". In combining physical materials, investigative imaging techniques and hands-on physical experiments this exhibition looks to do both. It also aims to go further and inspire the minds that will create the materials that will shape and benefit humanity well into the future.



SENTIENT MATERIALS

From plastics that bleed and self-heal to the world's lightest solid, these substances represent some of the most exciting and groundbreaking research in materials science. These smart materials can communicate, remember shapes and respond to a host of external stimuli—including temperature, stress, moisture, electric or magnetic fields.

SELF-HEALING PLASTICS
Plastics that bleed red when damaged and heal themselves when light or heat is applied.

SHAPE MEMORY METALS AND POLYMERS
Metals and polymers that deform at one temperature and recover their original undeformed shape upon heating.

SELF-HEALING PAINTS
A polyrotaxane-based paint that enables small grazes to heal within an hour and deeper cuts to heal in up to a week.

HYDROGEL
A network of flexible polymer chains that are hydrophilic and can hold up to 500 times their own weight in water.

AEROGEL
The world's lightest solid, created from a gel where the liquid component is replaced with a gas. A good thermal insulator that is used by NASA to collect stardust.

AUTO-HEALING POLYMERS
A silicon polymer sheet that when cut, forms new bonds and and can weld itself back together.

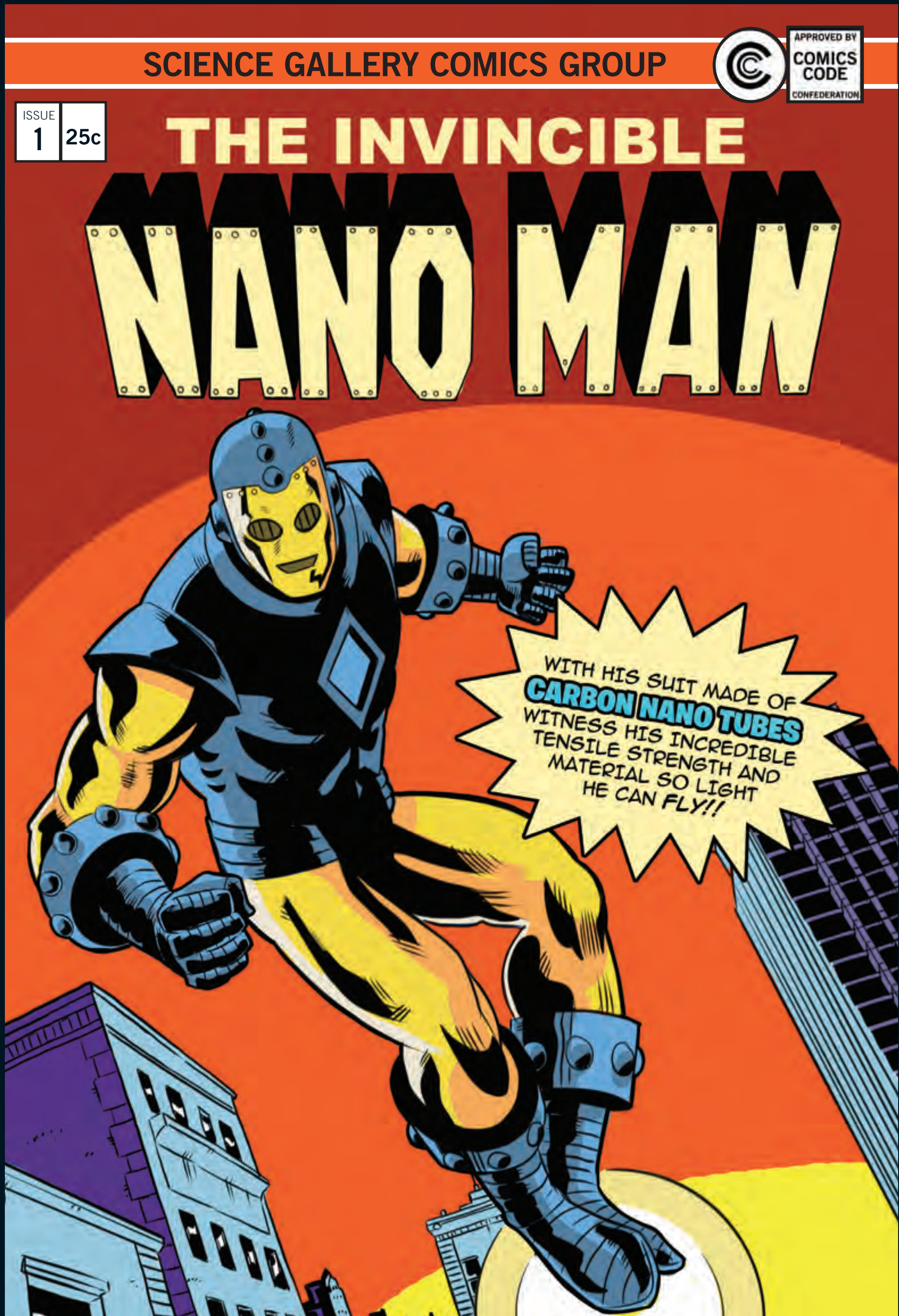
FERROFLUID
A liquid that becomes strongly magnetised in the presence of a magnetic field.

SHAPE-RETAINING PLASTIC
A polyethylene plastic that bends like a metal, but holds its shape unless you bend it back.

SUPER-ELASTIC PLASTIC
A thermoplastic that stretches to eight times its original size without ripping.

HAND-MOLDABLE PLASTIC
A polycaprolactone thermoplastic that has a comparatively low melting point of 60°C and can be melted and reformed into a new shape many times.

"Inspired by Sentient Materials, *Morph* is the leader of the group. His self-healing suit makes him resistant to anything his enemies can throw at him. He is the classic clean-cut good guy and the moral centre of the team."
Stephen Byrne



INVINCIBLE & INVISIBLE

INVINCIBLE & INVISIBLE includes everything from leading-edge nanoscience materials such as carbon nanotubes to re-imagined traditional materials like reverse-engineered silk. These materials are incredibly strong, while also being flexible, low density, conductive—and in some cases—biocompatible.

CARBON NANOTUBES [CNTs]

A nanometre scale tube of graphite carbon with incredible tensile strength [50–100 times stronger than steel at one quarter of the density] and semi-conductive properties. Variations in their length, thickness, layers and type of helicity [structure] can completely change their remarkable electrical properties.

SILK

A material as tough as kevlar that has existed for more than 5 millennia. It is biodegradable, can be used in microelectronics, is edible, sustainable and biocompatible. Researchers have recently genetically engineered silkworms to produce stronger and more elastic 'spider silk'.

SILICON NITRIDE

A compound of silicon and nitrogen that is incredibly strong over a broad temperature range. It's the material of choice for the ball bearings in NASA's Space Shuttle and is so strong it can smash concrete.

ALUMINIUM NITRIDE

An engineered ceramic that has extremely high thermal conductivity; meaning if you hold an aluminium nitride wafer in your hand for a short time, your body will provide enough heat for the wafer to cut through ice like butter.

TRANSPARENT CONCRETE

A strong concrete panel that is also transparent. This concrete transmits light due to the inclusion of glass fibres which also give structural integrity. Their small size means they just blend into the concrete.

SUPERCONDUCTORS

A metal that will conduct electricity without any resistance below a very low temperature, usually –234ºC. Superconductors repel magnetic forces below certain temperatures and in very special conditions demonstrate the remarkable phenomenon of quantum locking.

"I think of *Nanoman* as a billionaire with the funds to create an incredible a suit of carbon nanotube armor that is super strong but lightweight enough to soar into the sky."
Stephen Byrne

SMART CLOTHES

At the cutting edge of textile design, **SMART CLOTHES** include conductive fabrics that can power microelectronic devices, superhydrophobic materials and synthetic fabrics that can conserve body heat and promote increased blood circulation.

LUMINEX
A fabric with integrated optic fibres that can be arranged to power LEDs or integrated with sensors and microelectronics to create smart clothing.

DRYCOT
A polyester yarn made from 100% post-consumer recycled plastic bottles that feels natural. Fibres are arranged so moisture passes efficiently from the inside to the outside.

SHADOW50+
A fabric that absorbs and reflects UV radiation.

ENERGEAR
A fabric that reflects a body's Far Infrared Rays [FIRs] back to the wearer, promotes blood circulation and increases oxygen levels in the blood.

CONDUCTIVE FABRIC
A regular piece of fabric treated with a conductive polymer that has no effect on its strength, feel or flexibility—yet allows it conduct electricity.

TEMPERATURE-SENSITIVE POLYMER
A touch-sensitive colour-changing polyester that changes from black through the visible spectrum in between the temperature range of 25°C to 30°C.

CALO-TEX
Cotton impregnated with carbon nanotubes that enable it to be conductive and keep the wearer warm, which can also be used like a wire to power an LED.

SPACE SKIN
Reflects 97% radiated heat and has strong mechanical properties.

SUPERHYDROPHOBIC MATERIAL
An antimicrobial material that mimics the lotus leaf, repelling both water and blood.

ORICALCO
Fabric woven from a shape memory polymer that causes the fibres to contract in heat—so long sleeves on a shirt can suddenly become short sleeves.

OSMOTEX
A sealed 3D weave cooling textile with potential applications in air conditioning and cooling in buildings, garments, beds, seats, transport and medicine.

"When I first read about the ability of superhydrophobic materials to repel water, I immediately pictured a superhero who could sink to the depths of the oceans, without worrying about water pressure."
Stephen Byrne

POWERFUL & PLIABLE

These power-harnessing devices are research prototypes manufactured from materials such as graphene, photonic crystals and silver nanowires. They investigate and exploit properties such as conductivity, strength, optics and flexibility while also being lightweight. Applications range from flexible phone and computer displays to printable battery cells and lasers.

GRAPHENE

A single layer of graphite [the stuff in your pencil] and just one atom of carbon thick, it is 200 times stronger than steel, an excellent electrical conductor and impermeable. This superstar nanomaterial is the future of electronics, from fast transistors to transparent conducting electrodes, gas sensors to touch screens.

CARBON NANOTUBES [CNTs]

50–100 times stronger than steel at one quarter of the density and 10 times stickier than the adhesion forces of gekko feet, CNTs can be exploited in small electronic devices and in high strength composites used in anything from bridges to bicycle parts.

SOFT BATTERIES

An all-printed power source that is flexible and thin, made of low cost environmentally friendly materials, based on zinc and manganese dioxide. Used for low power applications in pharmaceuticals, cosmetics and RFIDs and functional embedded packaging.

PHOTONIC CRYSTALS

The optical equivalent of the semiconductor, with the reflection and diffraction properties of opal gemstones and certain butterfly wings. This opalescence allows the manipulation of light in a number of optical devices.

"I am always fascinated at seeing the near-future predictions for modern technology. Flexible screens are a common idea for the next generation of mobile devices. I decided to take this a step further and design a superhero whose suit is made of flexible technology, and a vast array of gadgets. Basically a much cooler *Inspector Gadget*."
Stephen Byrne

DYE-SENSITISED SOLAR CELLS

Titanium dioxide [TiO_2] photocatalytic nanoparticles, sandwiched between platinum coated glass plates and coated in the light absorbing dye for electrons to pass through. Extremely lightweight and flexible, the cells can even generate a portable form of electricity from the ambient light in your home.

SILVER NANOWIRES

Extremely strong and flexible material with good thermal conductivity. Imagine a computer screen that could be bent, folded in half, and even crumpled like a sheet of newspaper, without affecting its function in the slightest. Used as active components in electronic devices, biosensors and light harvesting systems.

SILICON

Silicon, chemically purified [and made from sand] is the most abundant element on earth after oxygen. It is made as wafers and used in electronic chip manufacturing because it is a natural semiconductor.

HELIUM ION MICROSCOPE

Affords the highest resolution surface imaging of bulk materials from a scanning microscope of 0.4 nanometres, to look at polymer based systems and biological specimens.

CLEAN & CLINICAL

CLEAN & CLINICAL explores microbial sensing and potential tumour detection on a nanoscale, self-cleaning and air detoxifying solutions such as superhydrophilic titanium dioxide, silver nanoparticles in wound management and medical imaging using quantum dots.

TITANIUM DIOXIDE [TiO_2]
Photocatalytic and low lux light solutions that can be coated onto many surfaces such as glass or hospital theatre walls to help them self-clean or purify the air around them.

SILICON CANTILEVER
Microbial sensors with selective coatings [eg. immunoglobulins] for targeted immobilisation of microbes determined by changes in vibration frequency, and which can determine the level of microbial activity in a drop of blood—invaluable for potential application in emergency and bedside testing for bacterial or viral infection.

NANOGOLD
A revolutionary biosensor based on engineered gold nanoparticles [the diameter of one is about 20 billionths of a metre], nanogold can be used to label proteins for tumour detection and diagnosis.

SILVER NANOPARTICLES
Triangular, hexagonal or disc-shaped nanoparticles with unique size-dependent optical, electrical, magnetic and anti-microbial properties. They form highly conductive wires and coatings for applications such as transparent electrodes, photovoltaic cells and wound management.

QUANTUM DOTS
Nanoscopic crystal semiconductors [of cadmium telluride or cadmium selenide] whose electronic and optical properties are related to the size, shape and composition of the individual crystal and fluoresce under UV light. Potential applications include in synthetic photosynthetic systems, transistors, solar cells, LEDs, diode lasers, medical imaging and quantum computing.

"I was fascinated by the power of air-purifying materials, which immediately summoned the image of a superhero fighting against fearsome toxic monsters. In my mind, Aero was an enviromental campaigner who gained powers to help fight his cause."
Stephen Byrne

DESIGNED BY NATURE

Inspired by the structure and function of biological systems, **DESIGNED BY NATURE** includes reverse-engineered spider silk, a synthesised substrate for bone cell growth and alternative materials that mimic photosynthesis.

SCAFFOLD FOR CARTILAGE GROWTH

A matrix developed through tissue engineering that can regenerate damaged tissues by combining cells from the body with highly porous scaffold biomaterials, which act as templates to guide the growth of new tissue.

ARTIFICIAL PHOTOSYNTHESIS

A biomimetic process that replicates capturing and converting sunlight energy, water, and carbon dioxide into carbohydrates and oxygen. Using CNT-embedded polymers or nickel-molybdenum-zinc films, this process replaces nature's use of pigments such as chlorophyll.

BIOGLASS SCAFFOLD

A tissue-engineered matrix with mechanical properties of high specific stiffness and strength. The glass scaffold is porous with a compressive strength comparable to that of cortical bone and important for a broad range of emerging applications, including filters, catalyst support, and tissue engineering scaffolds.

BIODEGRADEABLE PLASTICS

Plastics made from bacteria [PHB] and cornstarch [PLA] that degrade in soil with no adverse effects and that can dissolve in water [PVA]. All biodegradable with real commercial applications in the packaging industry—and potential to reduce our toxic landfill sites.

SILK

Silk is edible, biodegradable and implantable with strength, durability and a strong capacity to be conductive, fluorescent and drug-eluting. Potential applications include programmable biodegradable orthopaedic hardware, vein and artery replacement, drug storage and delivery systems, smart sensors [such as food ripening detection] and optical 3D display systems.

"*Florogirl* is an investigative reporter who was accidentally exposed to the properties of Nickel Molybdenum Zinc, and found herself able to imitate the process of photosynthesis by converting light from the sun and moisture in the air into energy. She uses her powers to create highly concentrated energy beams. I imagine that she can store up energy when fighting crime at night, but also runs the risk of running out of reserves."
Stephen Byrne

EXPERIMENTS

MAGICAL MATERIALS draws on the power of current research in materials science, which investigates the properties and functions of materials often at scales one billion times smaller than the naked eye can see. **MAGICAL MATERIALS** experiments and demonstrations allow the visitor to explore the world of materials science, from early prototypes to fully developed commercial, industrial and medical applications—happening locally at CRANN in Trinity College Dublin and also at an international level.

SENTIENT MATERIALS

Shape Memory Alloys [Film and samples]
Armin Lau & David Kiel, AVALON FP7 Research Consortium, Aarhus University, Denmark.

Light Sensitive Polymers
Silvia Giordani, Centre for Research on Adaptive Nanostructures and Nanodevices [CRANN], Trinity College Dublin [TCD], Ireland.

Cornstarch Vibration
Louise Bradley, CRANN, TCD, Ireland.

Ferrofluids
Éilis Mc Grath, CRANN, TCD, Ireland.

Shape Memory Polymer [video and samples]
Nick Puckett, AltN, Canada.

INVINCIBLE & INVISIBLE

Spider Silk Demonstration
Christopher Holland, Oxford University, UK.

Magnetic Levitation
Mike Coey & Karl Ackland, CRANN, TCD, Ireland.

Carbon Nanotubes
Johnny Coleman, CRANN, TCD, Ireland.

Nano Holograms
Graham Cross, CRANN, TCD, Ireland.

Invisibility Cloak Explanation Demonstration
Science Gallery, TCD, Ireland.

Quantum Levitation
Guy Deatscher, Mishael Azoulay & Boaz Almog, Tel Aviv University, Israel.

POWERFUL & PLIABLE

Vial of Graphene
Johnny Coleman, CRANN, TCD, Ireland.

Graphene Sonication and Graphene Strain Rubber System
Umar Khan, CRANN, TCD, Ireland.

Infinion CNT Wafer
Georg Duesberg, CRANN, TCD, Ireland.

Nanowires Flexible and Conductive Screen
Philip Lyons, CRANN, TCD, Ireland.

Remote Access to Helium Ion Microscope
Cathal McAuley, Advanced Microscopy Lab, CRANN, TCD, Ireland.

Graphene Battery
Valeria Nicolosi, CRANN, TCD, Ireland.

Photonic Crystals
Martyn Pemble, Tyndall National Institute, University College Cork, Ireland.

Dye Sensitised Solar Cell
Lorcan Brennan, Yurii K. Gun'ko, CRANN, TCD, Ireland.

Silicon
Leonard Hobbs, Intel, Ireland.

CLEAN & CLINICAL

Silicon Cantilever
Martin Hegner, CRANN, TCD, Ireland.

Silver Nanoparticles and Quantum Dots Display
Louise Bradley, John Kelly, Astrid Wachauer, Valerie Anne Gerard , CRANN, TCD, Ireland.

Nanogold Demonstration
Éilis McGrath, CRANN, TCD, Ireland.

DESIGNED BY NATURE

Collagen Scaffold and Cell Culture
Fergal O'Brien & Tanya Levingstone, The Bone and Tissue Engineering Research Group of the Royal College of Surgeons in Ireland [RSCI].

Stereo Microscope, Light Microscope and Inverted Microscope
Colin Darby, Micron Optical & Zeiss, Ireland.

Artificial Photosynthesis and CNT Embedded Polymer Film
David Coker & Laura Herz, University College Dublin [UCD], Ireland and Oxford University, UK.

Biodegradable Plastics
Trevor Woods [School of Physics, TCD], Maciej Guzik & Kevin O'Connor [School of Biomolecular & Biomedical Science UCD and the Environmental Protection Agency, Ireland].

Silk Bones, Food Sensors and Vein Replacements
Fiorenzo Omenetto, TUFTS University Boston, US.

Nitinol [NiTi] Heart Valve
Bruce Murphy, Biomechanical Engineering, TCD, Ireland.

EXHIBITS

Many of the materials explored in **MAGICAL MATERIALS** are still in the research lab and not yet realised in specific applications or products. This section presents a number of works by artists and designers responding to the potential of these innovative materials. Works like Miquel Mora's *Flat Futures* imagines a future of electronic paper based on advances in flexible electronics where we can crush an offending alarm clock with our hands. While other works like Victoria Vesna's *Blue Morph* and Iris Van Herpen's prints take inspiration from the mysteries of the nanoworld.

SENTIENT MATERIALS

Ferro Fluid [2011]
Perry Hall, US. [www.lovebrain.net]

INVINCIBLE & INVISIBLE

Space Elevator [1999]
Pat Rawlings, US. [www.patrawlings.com]

SMART CLOTHES

SEM Images [2012]
Iris Van Herpen, Bart Oomes & Stephen Meyer, The Netherlands. Copyright of The Groninger Museum. [www.irisvanherpen.com]

POWERFUL & PLIABLE

Flat Futures [2008]
Miquel Mora, Spain. [www.miquelmora.com]
Nokia Morph [2008]
Nokia Research Center [NRC] in collaboration with the Cambridge Nanoscience Centre, UK.

CLEAN & CLINICAL

Field of Jeans [2011]
Helen Storey, Catalytic Clothing, UK. [www.catalytic-clothing.org]

DESIGNED BY NATURE

Biophilia [2011]
Veronica Ranner, Germany. [www.vroniranner.bplaced.net]
Blue Morph [2007]
Victoria Vesna, US. [www.victoriavesna.com]
Silly Putty and the Index of Curiosity [2012]
Zoe Laughlin, Institute of Making, UK. [www.instituteofmaking.org.uk]

SCANNING ELECTRON MICROSCOPE IMAGES

These are a series of images captured by researchers in CRANN. The images give an insight into an atomic world, more than 10,000 times smaller than a human hair.

TiO_2 on FTO glass for solar cells [2012]
Yanhui Chen, China.
Living in a Graphene World [2012]
Niall McEvoy, Ireland.
Pac Man [Cantilever—Apsergillus fungus] [2012]
Michael Walther, Switzerland.
Connectivity in a Nanowire [2012]
Jessamyn Fairfield, US.
Bio Soup Pot [Collagen scaffold] [2012]
Eoin McCarthy, Ireland.
The Hive [Biodegradable polymer] [2012]
David McGovern, Ireland.
Split Ends 1 [Gekko Feet] [2011]
Brendan O'Dowd, Ireland.
Image 1 [Tarantula spider, silk secreting spigot] [2012]
Brendan O'Dowd, Ireland.
Fibre 2 [CNTs] [2011]
Karen Young, Ireland.
Magnetic Levitation [2012]
Karl Ackland, Ireland.
Raspberry [Aspergillus niger sporangiophore on microcantilever] [2012]
Jason Jensen, Ireland.
Photonic Jellyfish [2012]
David Mc Closkey, Ireland.
Cell Grapes [Culture of lung epithelial cells] [2012]
Dania Movia, Italy.

RATE MY RESEARCH

Memory of nanowire networks
Jessamyn Fairfield, CRANN, TCD, Ireland.
Graphene
Arlene O'Neill, CRANN, TCD, Ireland.
Cantilever
Sensitive Diagnostics, Jason Jensen, CRANN, TCD, Ireland.
Self cleaning materials and MRSA
Patrick Cronin, Nanonet Ireland, University of Limerick, Ireland.

MATERIAL REFERENCE

SENTIENT MATERIALS

Scratch Shield iPhone Case
Nissan Global, UK. [www.nissan-global.com]
Aerogel
Buy Aerogel, US. [www.buyaerogel.com]
Autoheal Polymers
Mindsets Online, UK.
[www.mindsetsonline.co.uk]
Hydrogel
Mindsets Online, UK.
[www.mindsetsonline.co.uk]
Hydrochromic Paint
Mindsets Online, UK.
[www.mindsetsonline.co.uk]
Ferrofluid
Mindsets Online, UK.
[www.mindsetsonline.co.uk]
Soft Magnets
Inventables, US. [www.inventables.com]
Shape Memory Polymers
Inventables, US.
[www.inventables.com] & Mindsets Online, UK.
[http://www.mindsetsonline.co.uk]
Shape Retaining Plastic
Inventables, US. [www.inventables.com]
Super Elastic Plastic
Inventables, US. [www.inventables.com]
Cold Forming Plastics
Mindsets Online, UK.
[www.mindsetsonline.co.uk]
Heat Shielding Gel
Inventables, US. [www.inventables.com]
Smart Putty and Smart Fluid
Mindsets Online, UK.
[www.mindsetsonline.co.uk]
Sugru Samples
Sugru, UK. [www.sugru.com]
Graphite Levitation Kit
Mindsets Online, UK.
[www.mindsetsonline.co.uk]
Superelastic Wire, Smart Wire,
Memory Spring, Memory Wire
Mindsets Online, UK.
[www.mindsetsonline.co.uk]
Magic Sand
Mindsets Online, UK.
[www.mindsetsonline.co.uk]

INVINCIBLE & INVISIBLE

Rain Campaign Sample
Fresh Green Ads, The Netherlands.
[www.freshgreenads.com]
Quantum Levitation Kit
Quantum Levitation, Israel.
[www.quantumlevitation.com]
Transparent Concrete
Litracon, Hungary. [www.litracon.hu]
Silicon Nitride Ball Bearing
Carter Bearings, UK. [www.carterbearings.com]
Aluminium Nitride Wafer
Valley Design, US. [www.valleydesign.com]
Silk Cocoons
Mindsets Online, UK.
[www.mindsetsonline.co.uk]

SMART CLOTHES

Drycot and Shadow50+ Fabric Samples
Filature Miroglio, Italy.
[www.filaturemiroglio.com/eng/newlife.php]
Oricalco, Calotex and Spaceskin Fabric Samples
Grade Zero Espace, Italy.[www.gzespace.com]
Coldblack and Energear Fabric Samples
Schoeller Textiles AG, Switzerland.
[www.schoeller-textiles.com]
Luminex Fabric Sample
Luminex, Italy. [www.luminex.it]
Conductive Fabric and Temperature
Sensitive Fabric Samples
Inventables, US. [www.inventables.com]
Electrotextiles
Mindsets Online, UK.
[www.mindsetsonline.co.uk]
Osmotex Cooling Textile
Osmotex, Switzerland. [www.osmotex.ch]

POWERFUL & PLIABLE

Soft Battery
Enfucell, Finland. [www.enfucell.com]
Conductive Paint
Bare Conductive, UK.
[www.bareconductive.com]
Carbon Sheet
Mindsets Online, UK.
[www.mindsetsonline.co.uk]

CLEAN & CLINICAL

Self Cleaning Materials
Nanoland Global [Dermott Reilly], Ireland.
[www.nanoland.net]
Pilkington Activ Self Cleaning Glass
Pilkington Glass, UK. [www.pilkington.com]

DESIGNED BY NATURE

Stereo Microscope, Light Microscope
and Inverted Microscope
Micron Optical & Zeiss, Ireland.
[www.micronoptical.com]

MAGICAL MATERIALS RESEARCHERS

Mary Colclough, CRANN, TCD
Maria Phelan, Science Gallery, TCD

MAGICAL MATERIALS EXHIBITION BUILD & DESIGN

Russellworks

MAGICAL MATERIALS GRAPHIC DESIGN

Ruža Leko

MAGICAL MATERIALS COMIC ART

Stephen Byrne

SUPPORTERS

FOUNDING PARTNER	wellcome trust
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Science Gallery at Trinity College Dublin is a world first, a space that ignites creativity and discovery where science and art collide. Since opening in early 2008, over 1 million visitors to Science Gallery have experienced 22 exhibitions ranging from light to love, from sustainability to infection. Science Gallery's 23rd exhibition, **MAGICAL MATERIALS**, is part of a vibrant 2012 programme, including **EDIBLE**, **HAPPY?**, **HACK THE CITY** and **GAME**. Science Gallery is an initiative of Ireland's leading research university, Trinity College Dublin and is kindly supported by the Wellcome Trust as founding partner, and by 'Science Circle' supporters DELL, Deloitte, Google, ICON and NTR Foundation. Science Gallery also receives government support from the Department of Jobs, Enterprise and Innovation, Department of Arts, Heritage and Gaeltacht and Science Foundation Ireland. For more information visit www.sciencegallery.com.

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