SEEING THE INVISIBLE ?

What is the Invisible, if not that which eludes our senses?

Isn’t the desire to explore what you can’t see some mild form of madness? And yet the tireless work of generations of craftsmen, technicians and scientists has helped us create some phenomenal tools that let us to go beyond appearances, capturing the very foundations of everything around us. Surprising worlds are revealed to us, brimming with beauty and mystery.

To begin this journey, we need to look at the different forms of the Invisible that already exist.

Imagine a microscopic universe, teeming with life, full of fascinating creatures and materials with unexpected morphologies, but so small that they are invisible to the human eye.

The Universe itself contains an incalculable number of gigantic galaxies, most of which are so far away from us that they are completely beyond what we can see.

And what about those strange stars that only manifest their presence through phenomena that are imperceptible to our senses? Then there are those phenomena that are linked to more abstract concepts, which can only be revealed within the mind. And what can we say about these living creatures who have mastered the art of disguise?

We invite you to follow our researchers on this journey into unknown territory, to unlock some of the secrets of our world and contemplate its beauty on every level.

To feel the passion of discovery and to lift the veil on knowledge in the making, for the joy of understanding, to try to solve today’s problems and help create tomorrow’s world...

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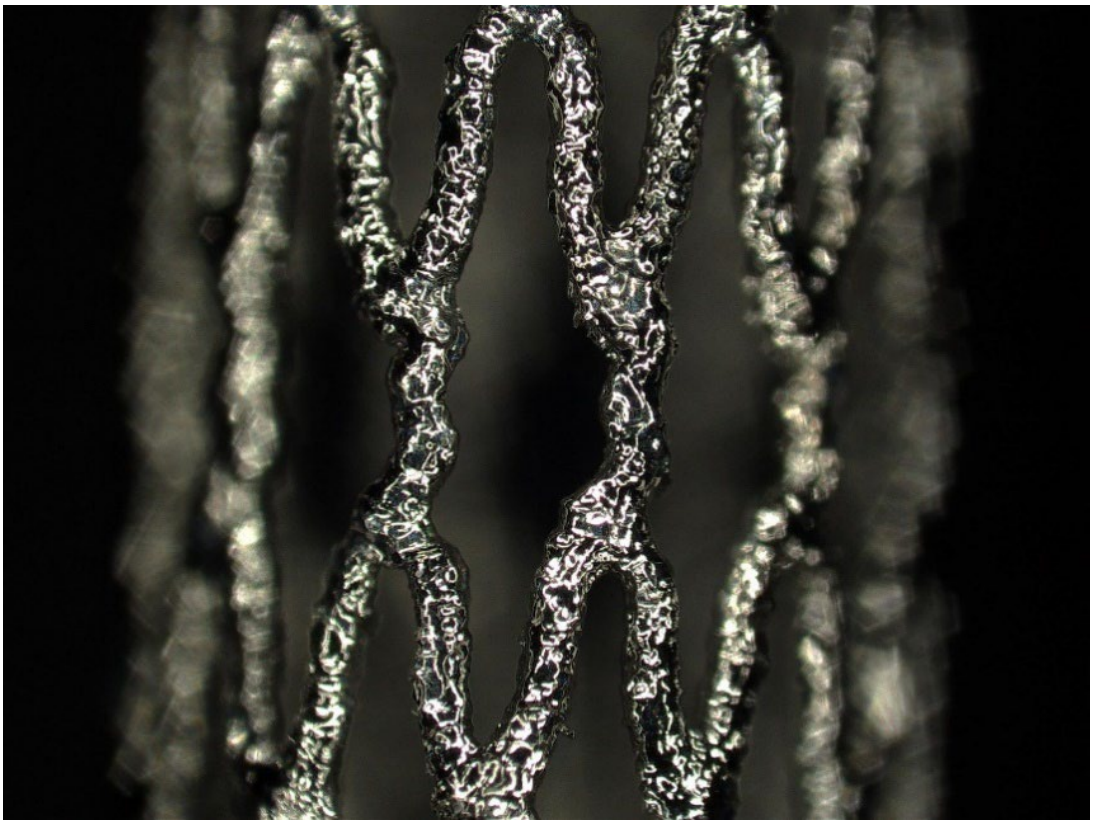
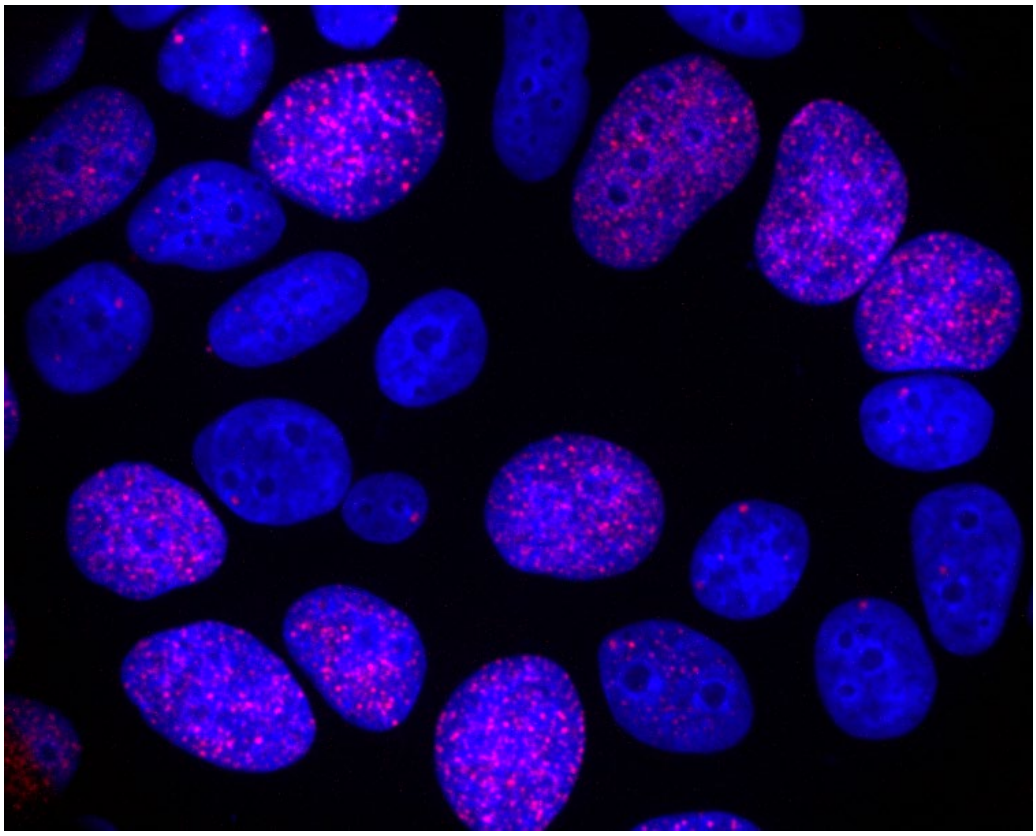


Country/University	Germany – Brandenburgische Technishe Universität (BTU)
Author Name	Christian Kehm, Aleksei Obrosov
Title	A custom printed stent
Year	2022
Imaging technique	Optical microscopy
Characteristic dimension	150 µm
Description EN	This section of a tiny metal mesh tube was made using additive manufacturing. It is part of a stent: a medical device implanted in patients during vascular surgery to widen narrowed blood vessels. This cylindrical stent structure is made from implantable steel grains. These grains have been fused layer by layer from a metallic powder bed into a three-dimensional structure using a laser beam.

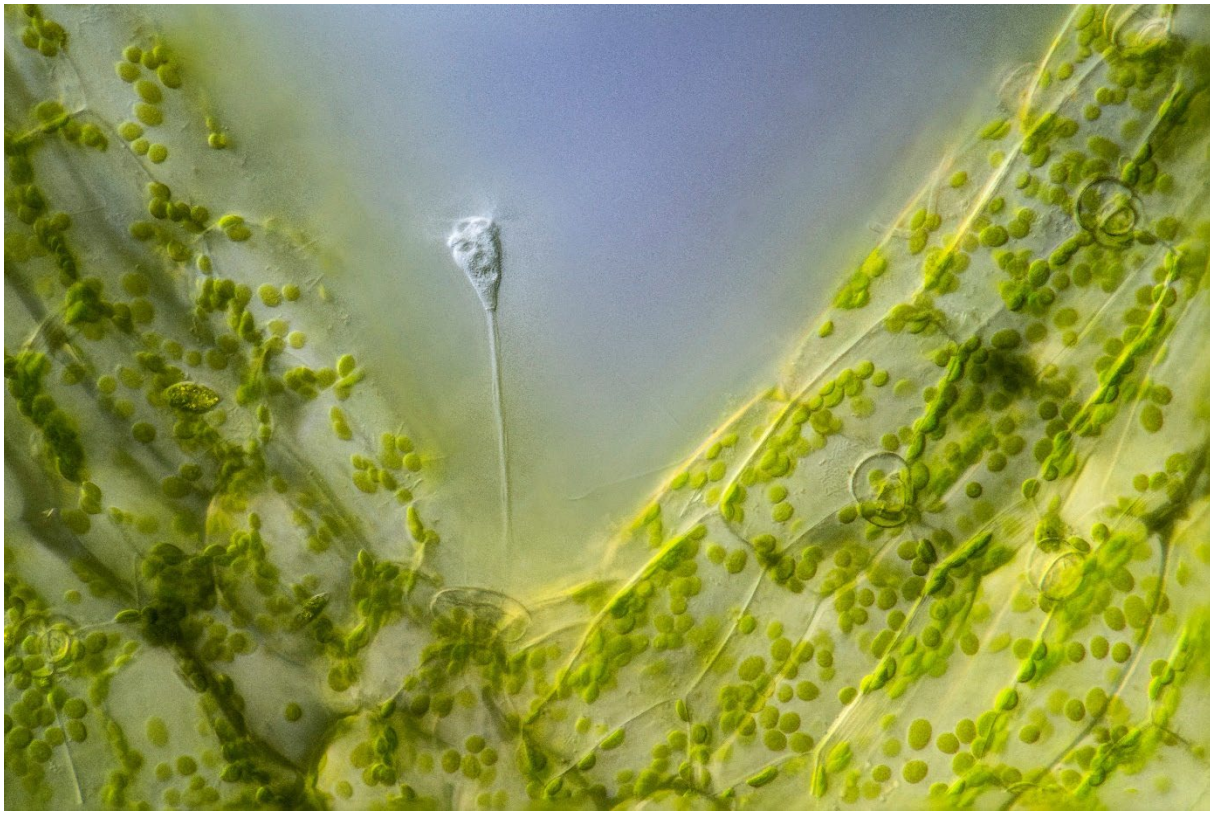


Country/University	Germany – Brandenburgische Technische Universität Cottbus-Senftenberg (BTU)
Author Name	Christian Kehm, Aleksei Obrosov
Title	Mushrooms to combat cancer
Year	2019
Imaging technique	Optical microscopy
Description	In these artificially blue-stained cancer cell nuclei, the pink dots represent the activity of oncogenic metabolites. Thanks to fluorescence imaging, we can see where these metabolites, called 4-hydroxycyclophosphamide metabolites, affect the double-stranded DNA in the nuclei of cancer cells. These metabolites are normally produced in the liver. Since their chemical synthesis is very complex and leads to low yields, the re-searchers used a fungal enzyme (the unspecific peroxygenase from *Marasmius rotula*) to produce them for the first time.

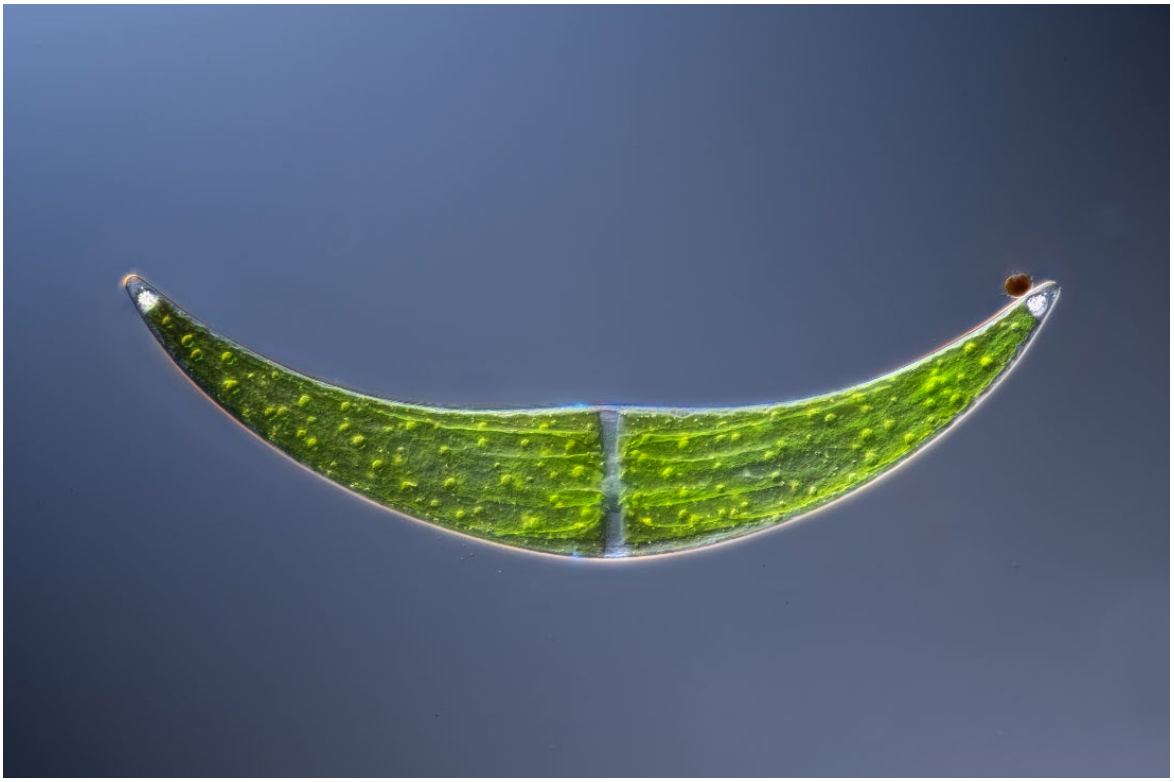
Country/University	Sweden, Karlstad University (KAU)
Author Name	Stephen De Lisle
Title	Antenna trap
Year	2023
Imaging technique	Technical details: 10x objective, differential interference contrast, z-stack
Characteristic dimension	2 mm
Description EN	As an evolutionary ecologist, Stephen De Lisle studies aquatic organisms. He pays attention to large but also micro fauna and flora. Like this head of a phantom midge fly nymph Chaoboridae. These nearly transparent insect larvae use modified antennae, visible as the long appendage in front of their head, to grasp their prey and bring them to their mouth.

Country/University	Karlstad University – Sweden (KAU)
Author Name	Stephen De Lisle
Title	Many children in the making
Year	2023
Imaging technique	This image is a stitched panaroma of 4 z-stacked frames, representing approximately 200 individual images made with a 10x objective in darkfield illumination.
Characteristic dimension	2 mm
Description EN	Copepods are small crustaceans whose adults often measure just one or two millimetres. Female cyclopoid copepods store their fertilised eggs in one or two egg sacks, until they hatch.

Country/University	Karlstad University – Sweden (KAU)
Author Name	Stephen De Lisle
Title	Parasitic bouquet
Year	2023
Imaging technique	Technical details: 60x oil immersion objective, differential interference contrast, z-stack
Characteristic dimension	0,35 mm
Description EN	Peritrich ciliated are protozoa, organisms that exist as solitary cells or colonies of cells. The ones pictured here live in colonies and have attached themselves to a midge fly larva (Chironomidae).

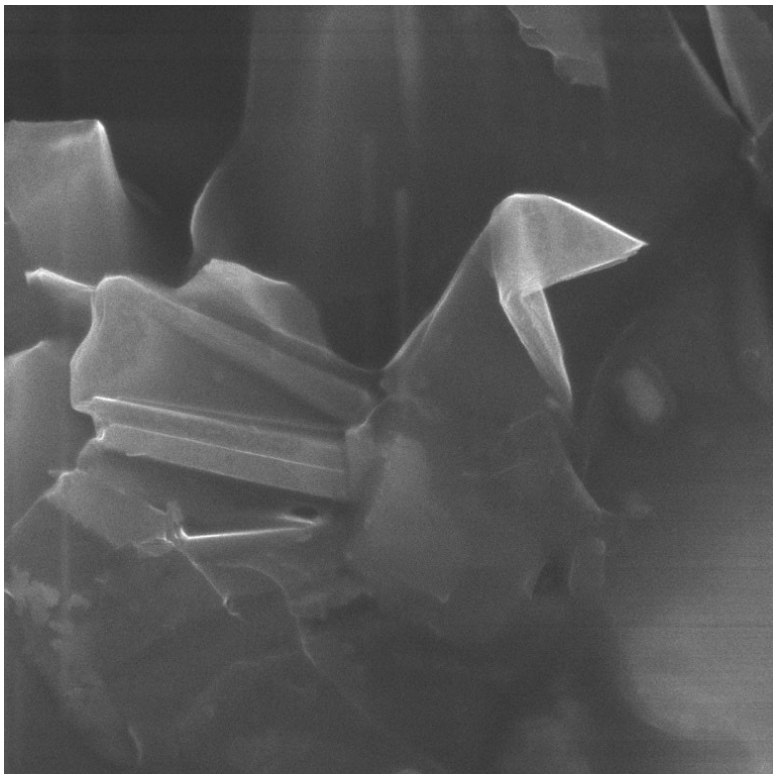


Country/University	Karlstad University – Sweden (KAU)
Author Name	Stephen De Lisle
Title	Growing in the valley
Year	2023
Imaging technique	60x oil immersion objective, differential interference contrast, z-stack
Characteristic dimension	0,35 mm
Description EN	A tiny Peritrich ciliate growing in the valley formed by the stem of a pondweed.

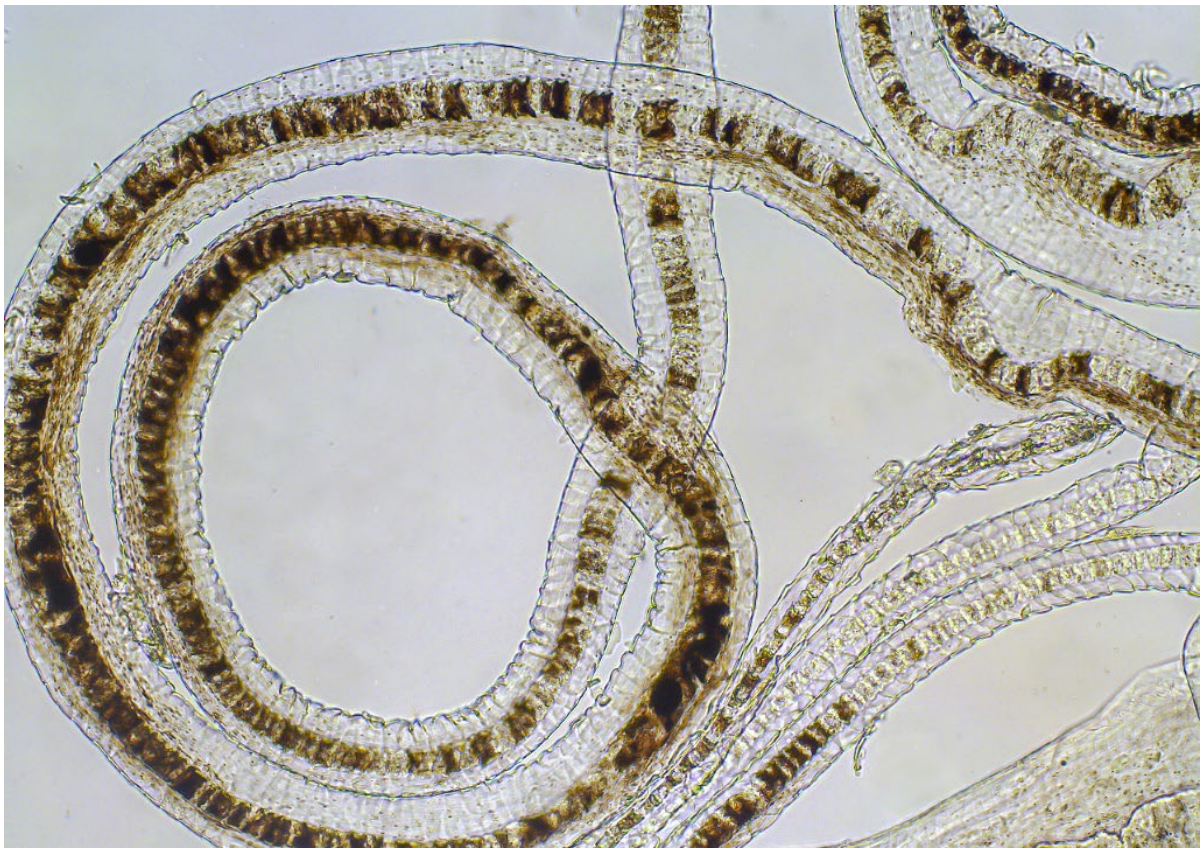


Country/University	Karlstad University – Sweden (KAU)
Author Name	Stephen De Lisle
Title	Green Moon
Year	2023
Imaging technique	Technical details: 40x objective, differential interference contrast, z-stack
Characteristic dimension	0,52mm
Description EN	Species of Closterium are a common component of freshwater microalgae flora worldwide. Here, we have an example of a single-celled Desmid green algae of the Closterium species. These solitary single cell is made of two identical halves called semicells. Image

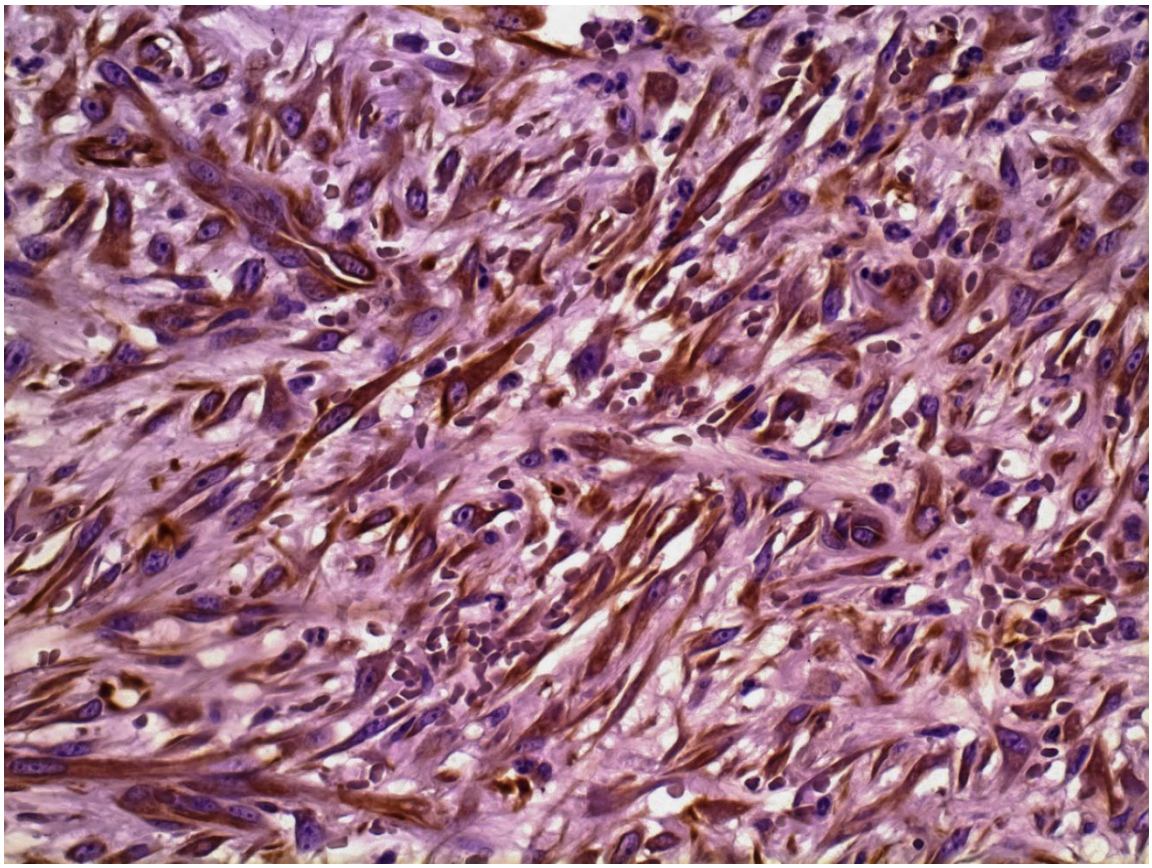
Country/University	Karlstad University – Sweden (KAU)
Author Name	Robin Söderlund
Title	The Frostcrystals Dance
Year	2022
Imaging technique	Macro photo, facing the sun. 1/10 post cropping, mirroring and different white balance.
Description EN	Close up shot on the forming frost on a branch. There is no way you can see it with your eyes. Thanks to the fantastic camera sensor and glass, I could. The facing sunlight causes extreme contrast which helps highlight the crystals glimmering parts and darkens the branch.



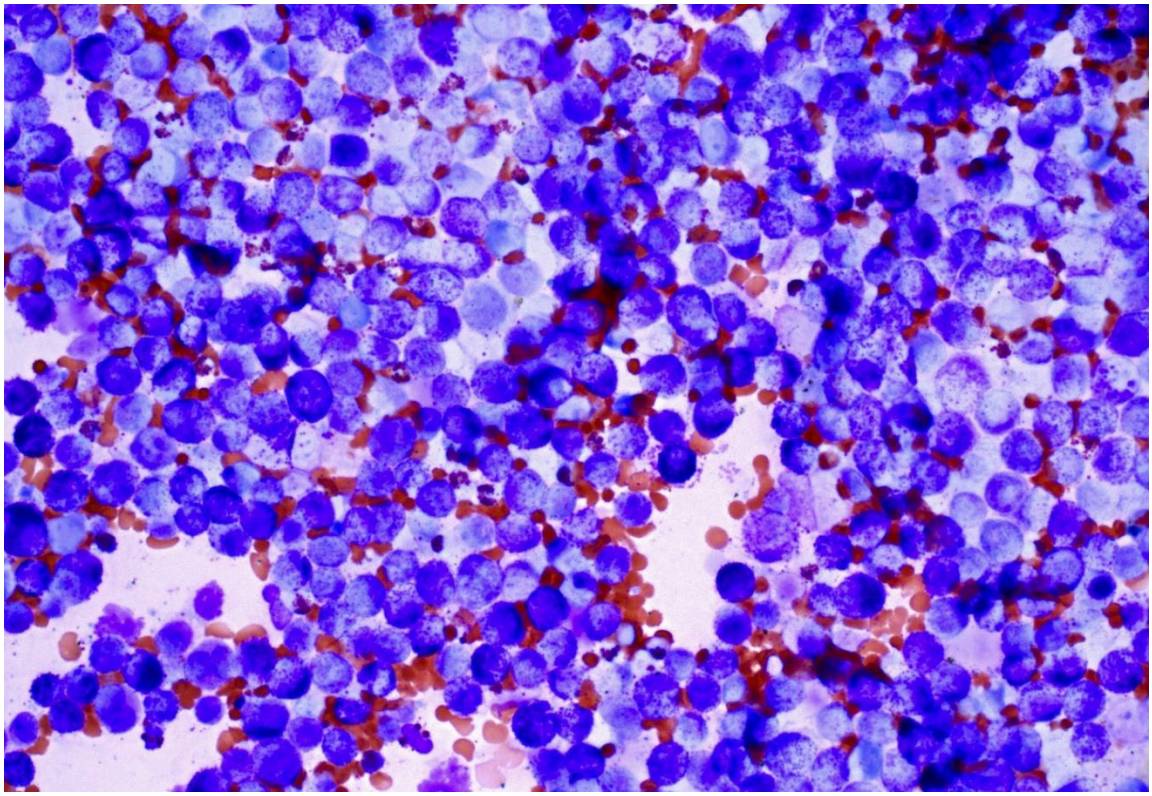
Country/University	Poland - Poznan University of Technology (PUT)
Author Name	Adam Piasecki, Jakub Zdarta
Title	Black Pigeon
Year	2023
Imaging technique	Scanning electron microscopy (SEM)
Characteristic dimension	4.15 x 4.15 µm
Description EN	This graphene structure looks like a pigeon made using the origami technique. Graphene is a two-dimensional, flat structure, composed of carbon atoms, which resembles a honeycomb in shape. Graphene has a number of unique properties, including good thermal and electrical conductivity, stability or the presence of reactive functional groups, which make it interesting for a number of practical applications. Graphene was here used as a carrier for the immobilisation of laccase, i.e. an enzyme that may find applications, among others, in the removal of harmful substances from water and wastewater.



Country/University	Portugal – Polytechnic of Viseu (PV)
Author Name	Helena Vala, Carla Garcia
Title	Hair in trouble
Year	2014
Imaging technique	Optical microscopy
Characteristic dimension	Full image: 506 µm (approximately half a millimetre)
Description EN	Microscopic examination of a dog's abdominal hair shows that the animal has a skin disease. Deformed hairs with a tortuous outline and abnormal melanin deposits make it possible to diagnose that the animal is probably suffering from colour dilution alopecia or colour mutants.

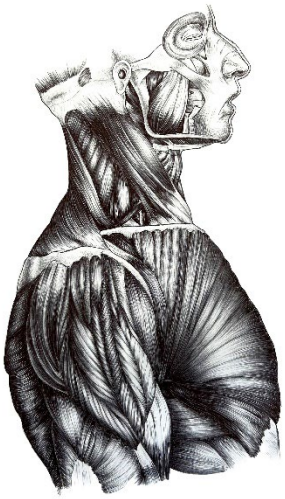


Country/University	Portugal – Polytechnic of Viseu (PV)
Author Name	Helena Vala, Carla Garcia
Title	What are they running to?
Year	2013
Imaging technique	Optical microscopy
Characteristic dimension	Full image: 252 µm
Description	The microscopic study of cells in which certain proteins have been marked beforehand enables the detection of cancerous cells. In malignant oncological diseases, where the cells are highly undifferentiated, this makes it possible to determine from which cell, tissue or organ the tumour has developed. In this image, taken from canine cells, it helped to diagnose a fibrosarcoma: a cancer that develops in the body's soft tissues.

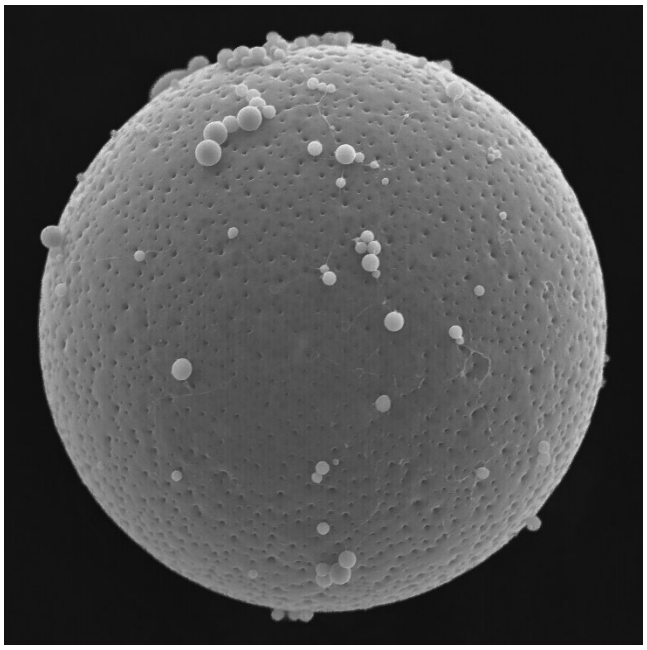


Country/University	Portugal – Polytechnic of Viseu (PV)
Author Name	Helena Vala, Carla Garcia
Title	The beauty of evil
Year	2014
Imaging technique	Optical microscopy
Characteristic dimension	Full image: 255 µm
Description EN	Observed under a 400 x magnification microscope, this sample of canine cells, predominantly round, shows mainly round nucleus, sometimes slightly eccentric, abundant, and a very grainy cytoplasm. These are malignant cells indicative of granular lymphoma in the animal, a type of cancer also found in humans that affects lymphocytes: a certain type of white blood cell.

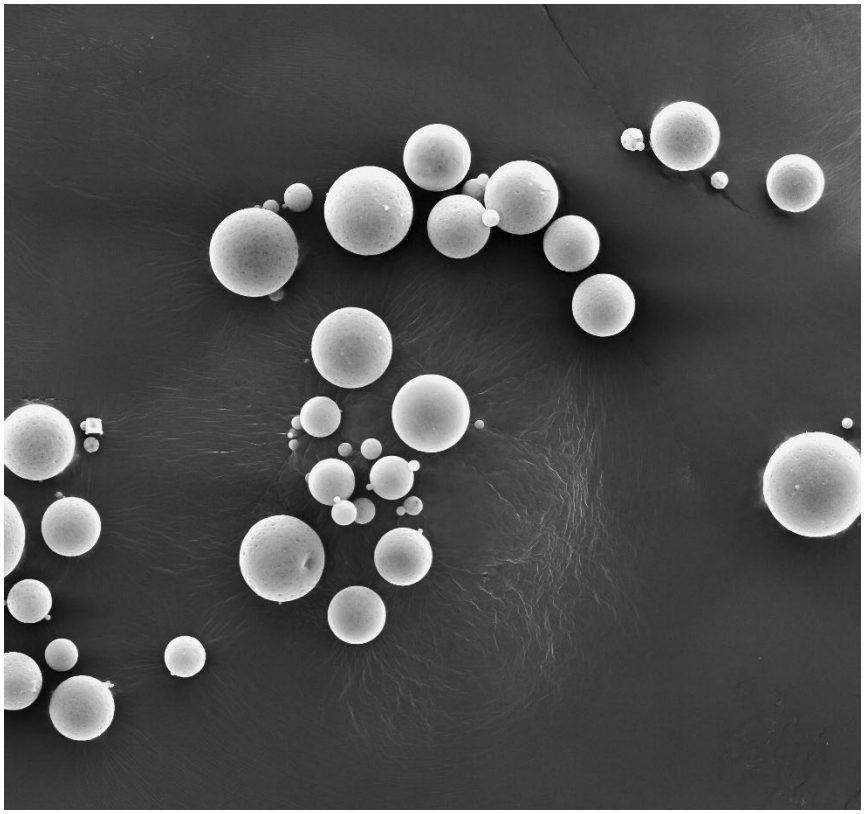
Country/University	Portugal – Polytechnic of Viseu (PV)
Author Name	Rui Pedro Duarte
Title	Fluffy
Year	2015
Imaging technique	Computer rendering
Characteristic dimension	1000 metres length by 800 metres height (representation of a cloud with that dimension).
Description EN	This cumulus cloud is not real. It has been computer generated from meteorological data. This image corresponds to a cloud generated over four hours. It represents the culmination of years of work in this kind of simulation. Real world cloud physics is a complex field. Cloud dynamics are very hard to reproduce using a computer. In this work, the cumulus has been generated in realtime using simplified physics and thermodynamic diagrams. The incorporation of meteorological approaches in computer graphics represents a novel field of investigation.



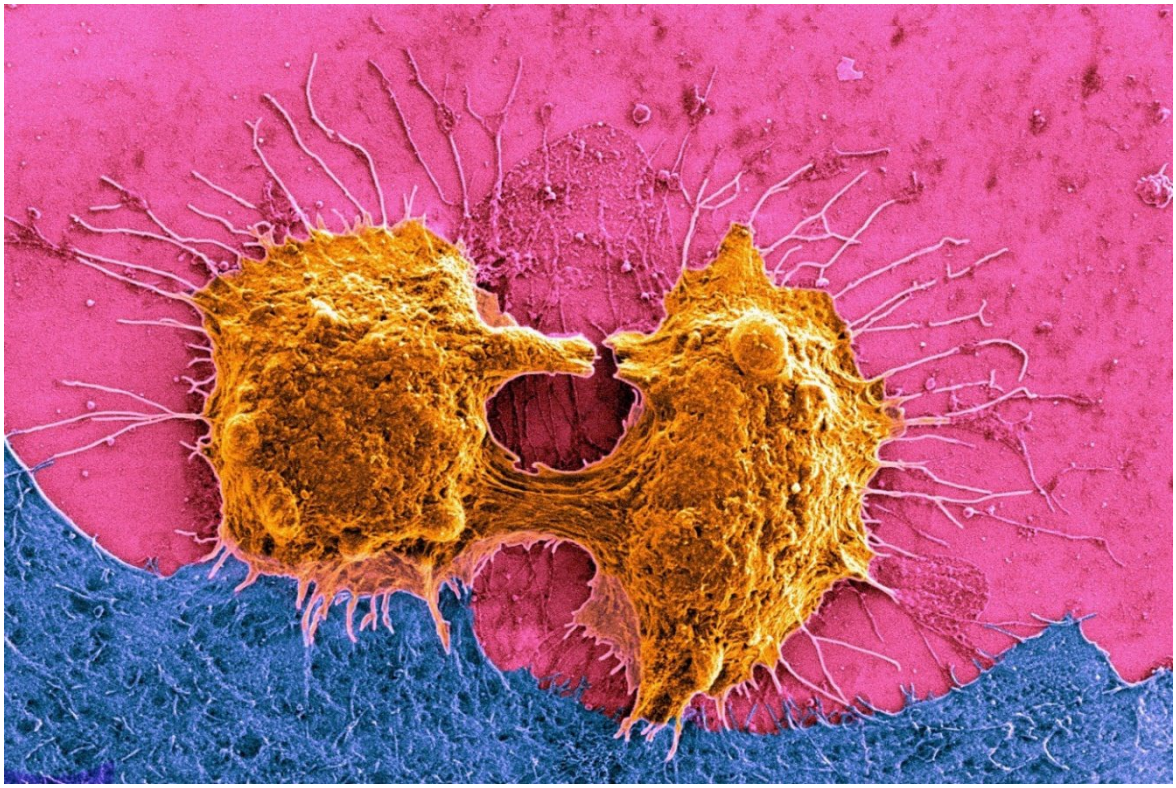
Country/University	Portugal – Polytechnic of Viseu (PV)
Department name	School of Education of Viseu – Department of Communication and Art
Author Name	Ana Catarina Soares Garcias, Marlene Ribeiro
Title	Is this a nude?
Year	2023
Imaging technique	Drawing (black pen on paper)
Characteristic dimension	[human chest]
Description EN	Drawing is a spontaneous way to record the world around us, to understand the meaning of things, to express our emotions and desires, to communicate with others and to think. It is, therefore, through an author, an intention and a representational instrument that drawing can make the invisible visible. Using a regular finetipped black Bic pen on paper, the author offers us the possibility of seeing revealed, by rigorous and eloquent resemblance to the represented object, the invisible different muscles of the upper limbs of the human body.



Country/University	Portugal – Polytechnic of Viseu (PV)
Author Name	Luisa Hora de Carvalho, Jorge Martins Fernão Magalhães (FEUP)
Title	There's tiny and there's tinier
Year	2017
Imaging technique	Scanning Electron Microscopy
Characteristic dimension	120 µm
Description EN	This tiny ball is actually a multi-coated particle of styrenecross-linked unsaturated polyester. It is produced in a single step and can replace the titanium pigments (TiO2) generally used to colour the wood fibres that make up MDF (Medium Density Fibreboard) panels. White and pastel-coloured MDF is of interest to the furniture sector. But producing it is a huge challenge, because of the colour of the wood fibre itself. These particles can do the job, thanks to their multi-hollow structure that enhances light diffraction.

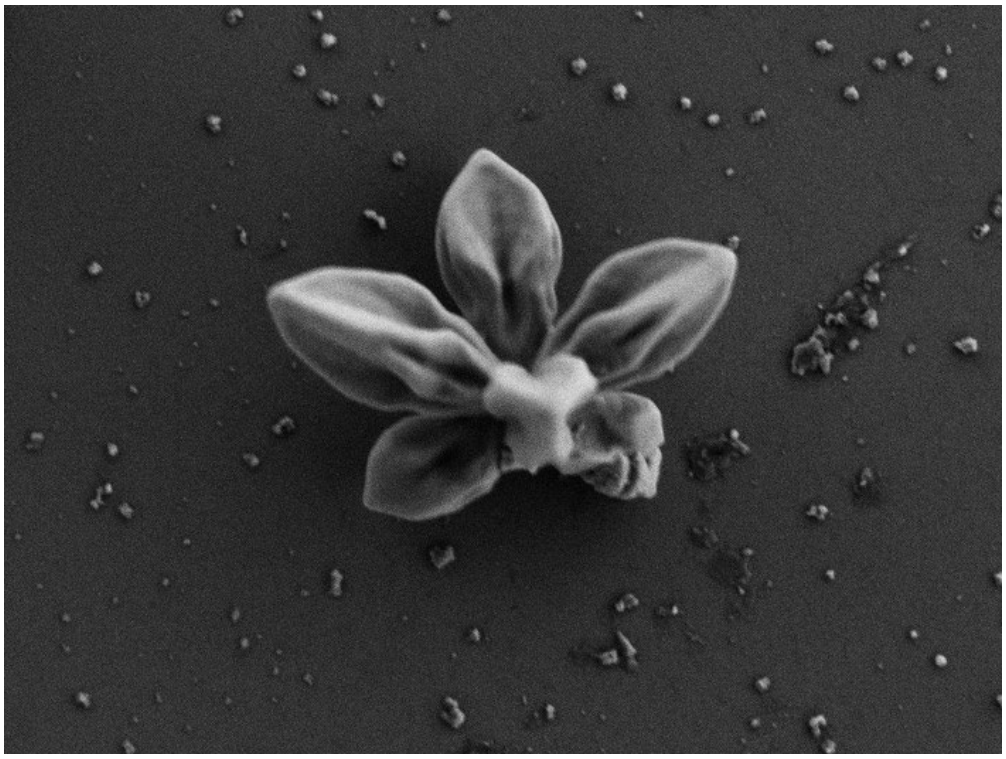


Country/University	Portugal – Polytechnic of Viseu (PV)
Author Name	Luisa Hora de Carvalho, Jorge Martins, Sandra Monteiro (ARCP)
Title	Hanging around
Year	2017
Imaging technique	Scanning Electron Microscopy
Characteristic dimension	268 µm (particles with sizes from 5 to 40 µm)
Description EN	Multi-hollow particles (MHP) are spherical particles with holes in the surface, associated with the collapse of the walls of the outer voids. They can be used to replace titanium in the whitening and colouring effects of various materials, such as wood particles or thermoplastics. In waterbased paints, the addition of hollow polymer particles improves opacification. This is due to the refraction of light at the air/polymer interface.

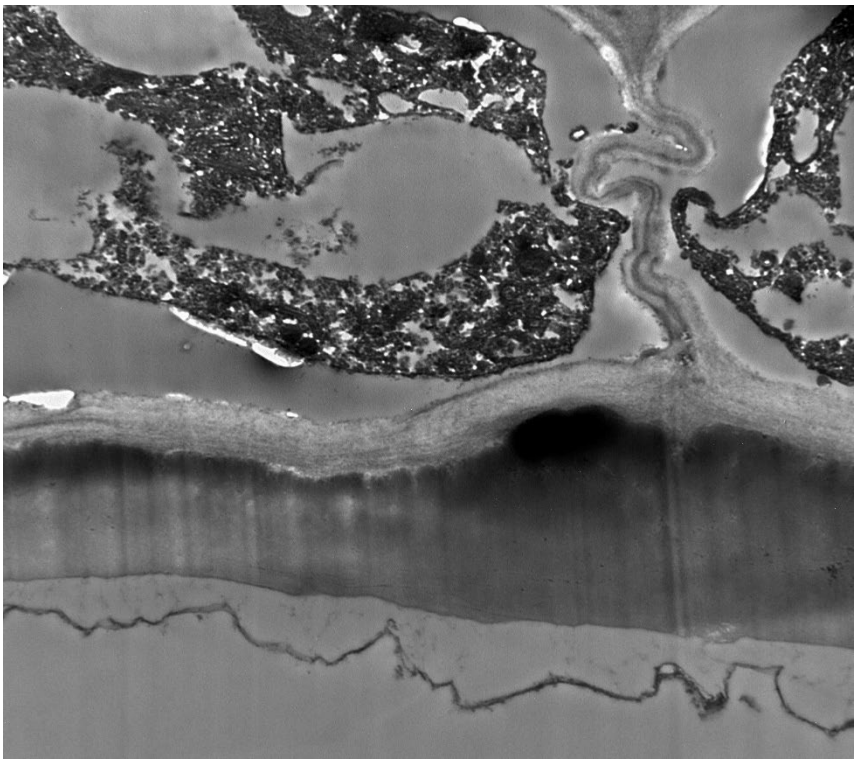


Country/University	Spain – University of Cantabria (UC)
Author Name	Lorena García Hevia
Title	The kiss
Year	2019
Imaging technique	Scanning Electron Microscopy
Description EN	A cancer cell undergoing division gives birth to two new cells. They are still connected by a delicate membrane, giving the impression that they are gently touching each other, as if in an intimate embrace. By visually documenting cell division, researchers can identify abnormalities specific to cancer cells, providing insights into how cancer develops and spreads. This has implications for the development of new treatments aimed at disrupting cancer cell division and preventing metastasis.

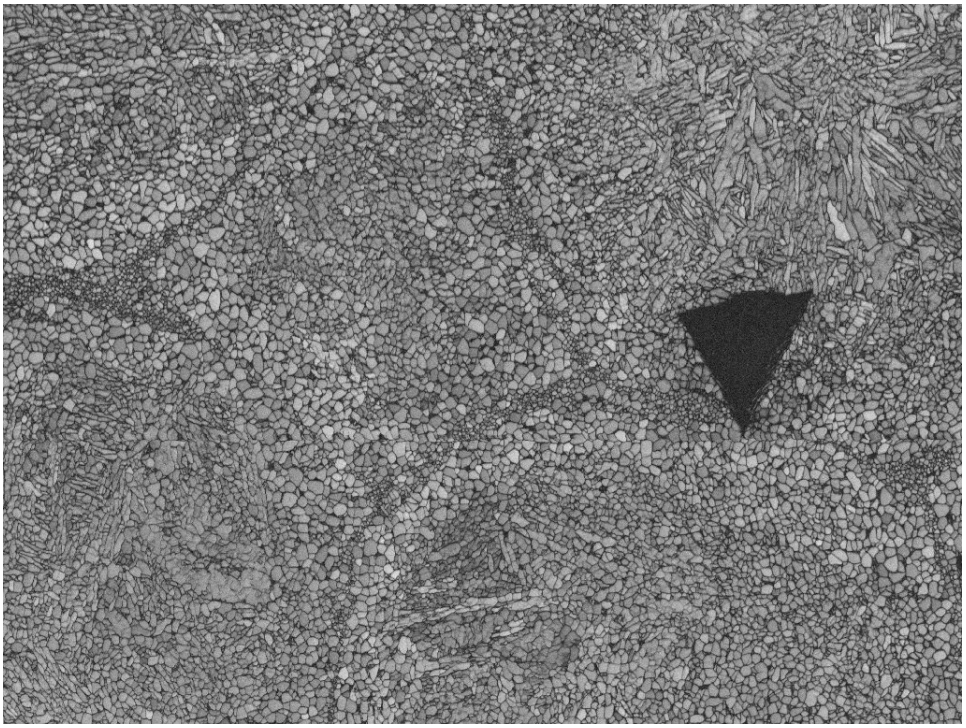
Country/University	Spain - University of Cantabria (UC)
Author Name	Alicia Sanz-Royo, in collaboration with Museo Nacional y Centro de Investigación de Altamira, Ministerio de Cultura y Deporte de España.
Title	Smile!
Year	2021
Imaging technique	Photografic camera
Description EN	Did you know that the cave bears (*Ursus spelaeus*) from the past were mainly herbivores? The shape of their teeth, such as this molar from 45,000 years ago, found at El Castillo cave (Cantabria), shows that these animals were indeed well adapted to this diet.The teeth give scientists a lot of information about the animals that lived in a particular area, as their age and their diet. In this cave, the presence of Neandert hals and *Homo sapiens* have also been documented, who had to share their living environment with other animals, such as… bears! This tooth also givesscientists another clue: cave bears hibernated during the winter and the weakest individuals could not survive, remaining their bones inside of El Castillo cavefor thousands of years.



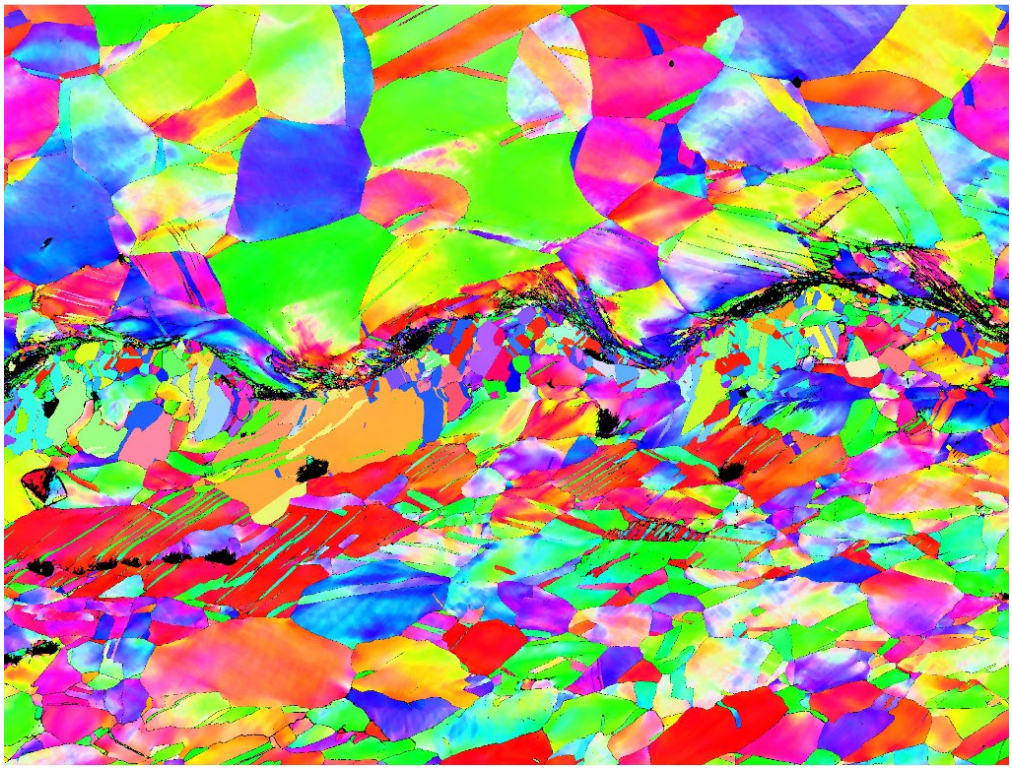
Country/University	Italy – University of Catania (UNICT)
Author Name	Andrea Lo Mastro
Title	Stranger Nanoflower
Year	2023
Imaging technique	Scanning Electron Microscopy
Characteristic dimension	4 micrometers
Description EN	This nanostructure was found through Scanning Electron Microscopy (SEM) of a solution poured drop by drop onto a flat silicon substrate. The solution was thought to consist only of thin molybdenum oxide nanowires dissolved in isopropyl alcohol. The intriguing "flower" in the picture, which somehow resembles a monster from the TV series Stranger Things, is less than 4 micrometreswide. Later analysis of the same sample showed that the solution was contaminated, so the flower was a lucky find.



Country/University	Italy – University of Catania (UNICT)
Author Name	Paolo La Spada
Title	The hidden artwork of fruits
Year	2023
Imaging technique	Transmission electron microscopy (TEM)
Description EN	The surface of all organs in plants, excluding the woody parts, are covered by a cuticular layer and waxes. Understanding the role of these layers during fruit growth, development, and ripening (e.g. in Vitis vinifera L.) will provide insights into thermal regulation, transpiration, resistance to parasites, and mechanical resistance. These informations are incredibly valuable for understanding how the crops face the biotic and abiotic stresses enhanced due to climate change.

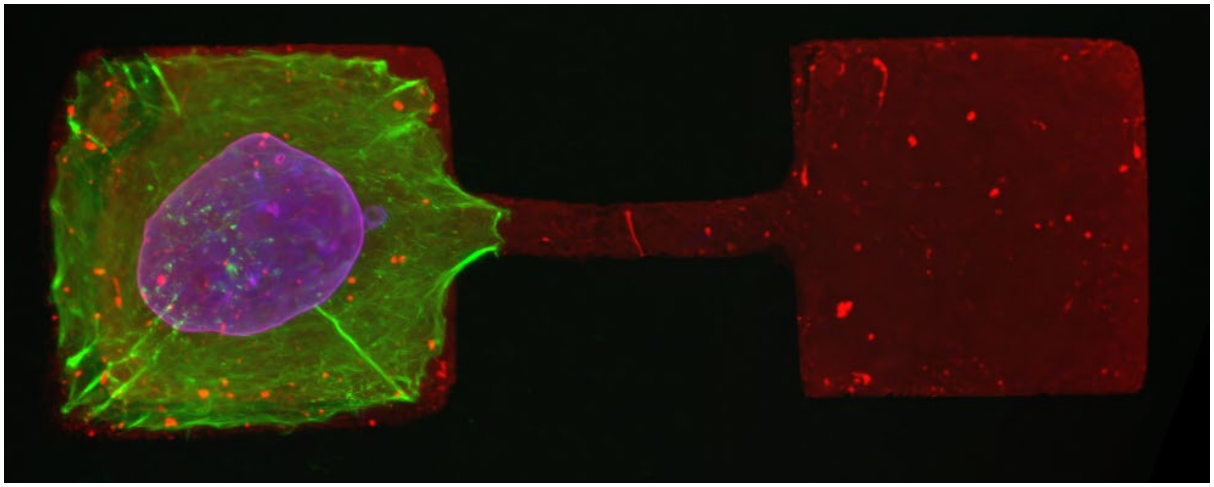


Country/University	France – Université Polytechnique Hauts-de-France (UPHF)
Author Name	Tarik Sadat, Rudy Dubois, José la Barbera, Guy Dirras, Kei Ameyama
Title	Hightech dust that can be used to make knees, hips and even airplanes!
Year	2022
Imaging technique	Scanning Electron Microscopy
Description EN	Titanium alloys are commonly used in implants and medical devices such as hip or knee prostheses. A detailed knowledge of their microstructure can contribute to the development of new, even safer or stronger devices. The titanium alloy studied here under an electron microscope has harmonic characteristics. Harmonic alloys are made from metal powders and are composed of grains of different sizes. Harmonic alloys can lead to the development of stronger and more durable materials, for implants but also for aircraft and even spacecraft.

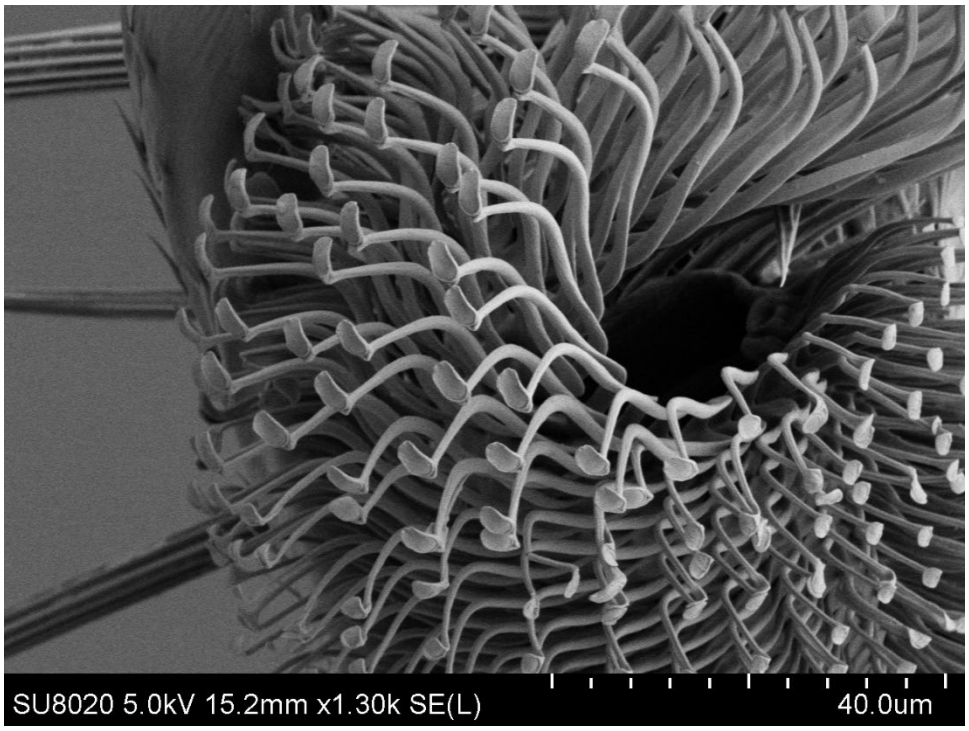


Country/University	France – Université Polytechnique Hauts-de-France (UPHF)
Author Name	Zielinski Benjamin, Dubois Rudy, Sadat Tarik, Markiewicz Eric and Dubar Laurent
Title	And in the middle flows a river…
Year	2022
Imaging technique	Scanning Electron Microscopy
Description EN	Copper soldering on a copper surface: this leaves traces. In this image, it is possible to observe a clear separation between the two coppers via an interface in the form of waves. Thanks to the scanning electron microscope, we can observe here the grains composing the two materials as well as their orientation. This allows us to better understand the impacts of the soldering process on the materials.

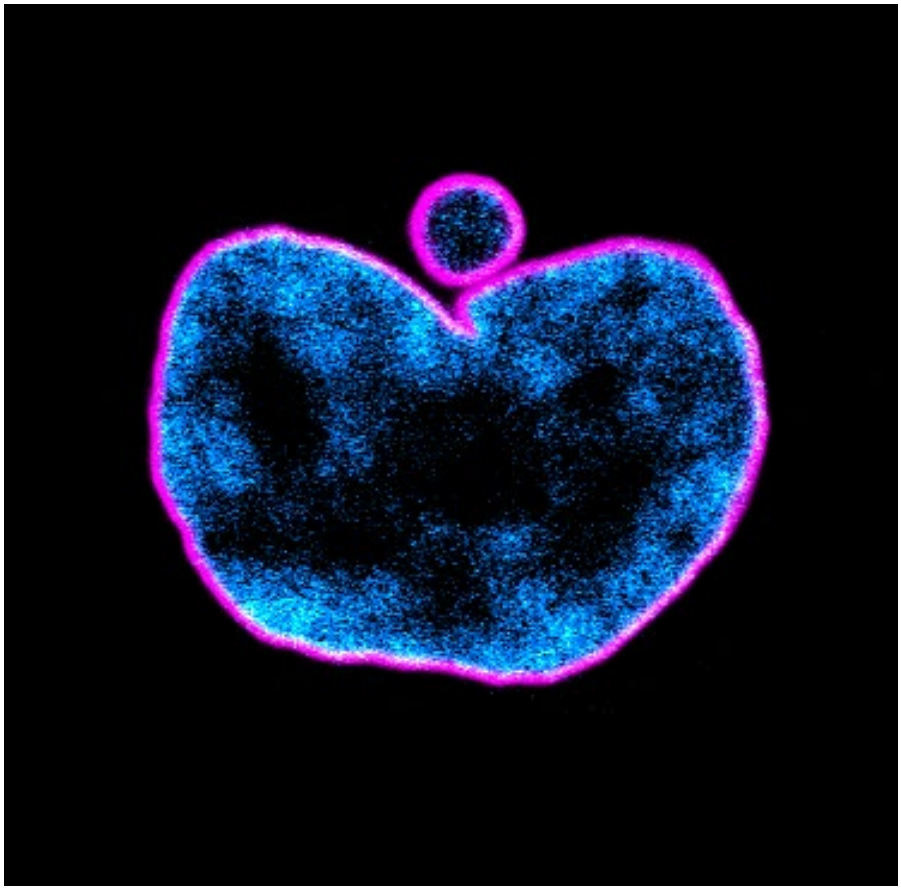
Country/University	Belgium – University of Mons (UMONS)
Author Name	Brieux Colette
Title	Palpatine
Year	2020
Imaging technique	Scanning Electron Microscopy
Characteristic dimension	300 µm
Description EN	No, this is not a character who has fallen to the dark side of the Force, hooded and emerging from the darkness! It is a mite, an eight-legged organism, classified in the same group as spiders and pycnogonids: chelicerates. There are more than 50,000 species of mites in the world and they are present everywhere. Some even give their color to certain cheeses - mimolette for example, while thousands of similar microscopic individuals are currently wandering... on your skin. Don't panic, they clean excess sebum and keep your skin healthy.



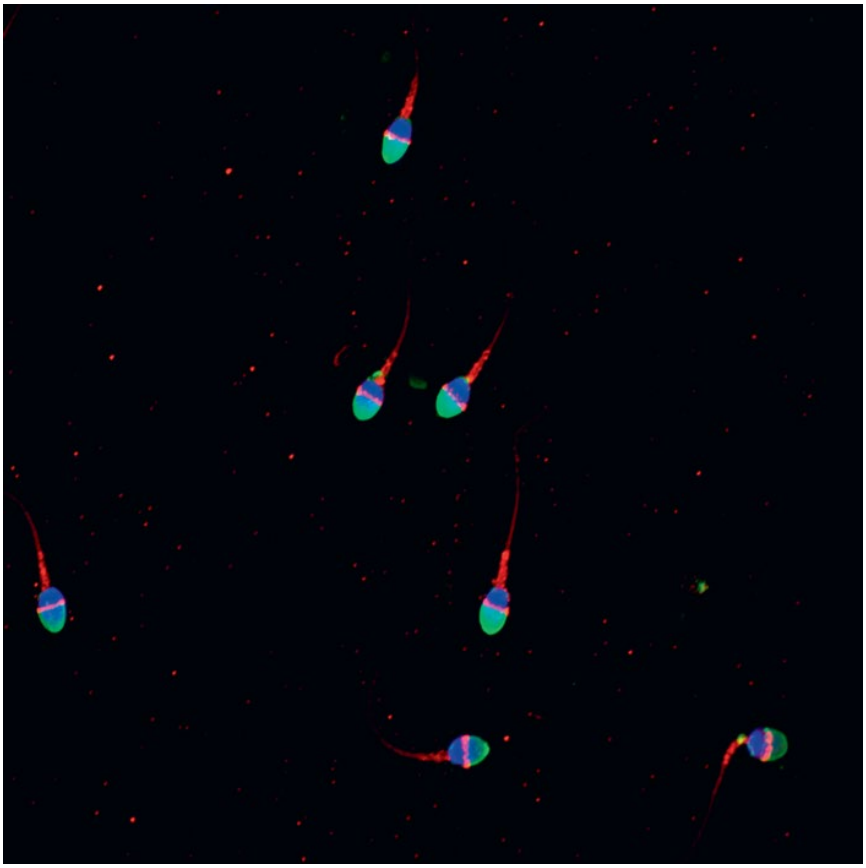
Country/University	Belgium – University of Mons (UMONS)
Author Name	Yohalie Kalukula
Title	Cellular mechanics
Year	2021
Imaging technique	Scanning Electron Microscopy
Characteristic dimension	Dimensions patron carré : 40 µm × 40 µm
Description EN	Cells are able to deform - and even move - thanks to their cytoskeleton, which is composed in particular of actin filaments, visible in green. This study explores the mechanics of a breast cancer cell. Here, it perfectly matches the shape in which it was deposited. It is even able to pass alternately, via the small bridge, from one end to the other of the device imagined by the researchers.



Country/University	Belgium – University of Mons (UMONS)
Department name	Materia Nova
Author Name	Yoann Paint
Title	Hooks and feet
Year	2022
Imaging technique	Scanning Electron Microscopy
Characteristic dimension	80 µm
Description EN	And here is a pest that arouses the curiosity of a microscopist: a fly. Hop hop, there it is in the microscope that reveals to us a myriad of mini-feet under a single foot! The foot! Spatula-shaped, these microscopic hairs allow it to adhere to the smoothest surfaces by defying the laws of gravity. An ability that encourages chemists to develop new bio-inspired adhesives.



Country/University	Belgium – University of Mons (UMONS)
Author Name	Yohalie Kalukula
Title	Seed
Year	2021
Imaging technique	Microscopie confocale à balayage laser
Characteristic dimension	15 µm
Description EN	The use of fluorescent molecules has made it possible to study the shape of the nucleus of a cancer cell. The DNA appears in blue and the nuclear membrane in purple. Verdict: this nucleus is far from spherical. The small circle at the top of the image is a micronucleus, a sign of a typical anomaly that occurs when cancer cells divide.



Country/University	Belgium– University of Mons (UMONS)
Author Name	Elise Hennebert
Title	Oops…
Year	2022
Imaging technique	Confocal fluorescence microscopy
Characteristic dimension	Head length : 5 µm
Description EN	Did you know that in 1970, a human sperm sample contained on average more than 100 million spermatozoa per milliliter, while today, this figure has dropped to 50 million? According to the most alarming projections, there will be no more fertile men by 2050. What are the mechanisms behind this drastic drop in male fertility?