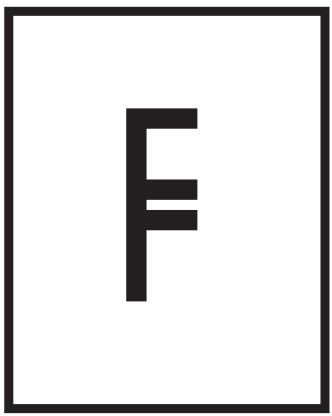
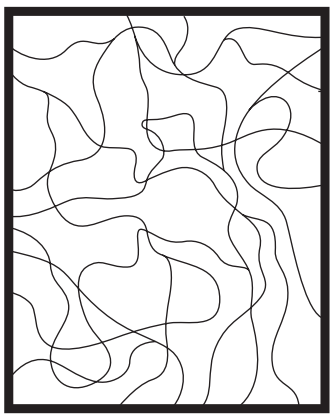
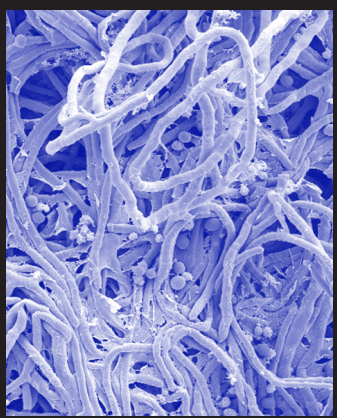
01



FUNGAL FUTURES





An exhibition about our Upcoming Future.
Shaped by novel materials and processes
relying on the fundamental role
of fungal micro-organisms.
A historical greenhouse, filled with projects
envisioning novel advancements and potentially
near futures, while re-imagining the way in
which our domestic and social life will morph
during the next decades.

FUNGAL FUTURES /
Growing Domestic Bio-Landscapes, presents the work of an international group of artists and designers who develop innovative materials and applications using mycelium, the rhizomic network of 'fungal roots'.

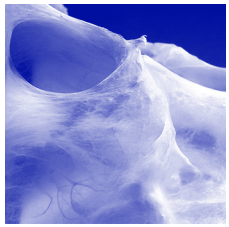
Fungal mycelium consists of a dense network of interlocking filamentous cells, called hyphae.
The mycelium can break down plant matter and convert the breakdown products while extending its network of hyphae. This fungal behavior can be used to create biomaterials with novel properties.
The materials may consist of a mixture of waste stream and mycelium (composites) or can be completely 'pure'. Fungal materials represent attractive alternatives to traditional synthetics as they are 100% natural, fully compostable, and resulting from waste streams.

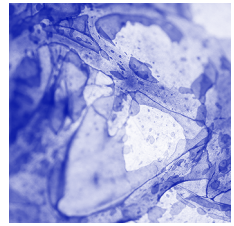
The NWO project 'Mycelium Design' (Jan 2014-Dec 2015) enabled collaboration between Utrecht University, Officina Corpuscoli and Stichting Mediamatic.
Through an open call, the partners have invited artists and designers to participate in the project as part of the Myco Design Lab.
Along the duration of the project, Officina Corpuscoli and Utrech University developed a palette of materials by making use of natural variation, environmental growth conditions and genetic modification.
These materials were provided to the selected artists and designers, who explored their potential (qualities and opportunities) and provided feedback about the way properties needed to be improved to meet

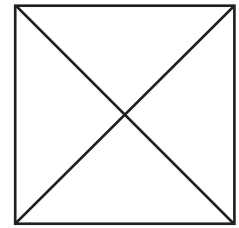
requirements for a range of specific products and applications. The projects on show as part of FUNGAL FUTURES, have all been developed as part of innovative research processes that operate at the intersection of design and science.
The creatives, working in direct consultation with scientists, have adopted and developed unorthodox novel methodologies and techniques, as part of their practice.

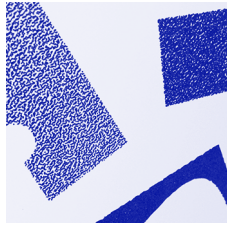
FUNGAL FUTURES presents work of designers and artists who were involved in the NWO project 'Mycelium Design', as well as projects of selected invited creatives working along the same principles. The exhibition aims to demonstrate the generation of a near future in which fungal organisms will be one of the main actors leading towards a responsible social development.

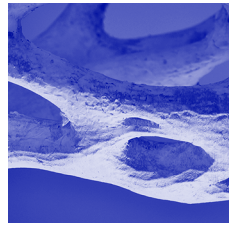
In the Oude Hortus in the Universiteitsmuseum Utrecht, a constellation of tangible visions demonstrates how working with living organisms and systems could lead to ground-breaking innovative outcomes affecting society and the ecosystem we are part of while informing and impacting current existing paradigms, systems and networks.

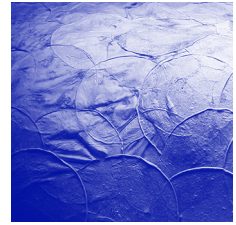












Contents

Molding Fungi /

Fungi grow by means hyphae.
These filaments have a diameter of about 1/100th of a millimeter and a length that is multitudes longer. Hyphae grow at their tips and branch regularly, thus forming an interconnected network known as mycelium. When viewed under a microscope the mycelium shows similarity with a woven fabric.

Mycelia usually go undetected because they are formed within the soil or within organic waste. Yet, they are very abundant in nature illustrated by the fact that one gram of soil can contain several kilometers of hyphal filaments. Mycelia can be seen with the naked eye once they have escaped the substrate to grow into the air to form reproductive structures. In this case they have a fluffy appearance.

Mushroom forming fungi can colonize large surfaces. For instance, a mycelium of a honey mushroom was found to have colonized more than 1000 hectares of soil making it the largest organism on earth (Smith and Anderson, 1992).
Rapid hyphal growth and the secretion of acids and antibiotics are strategies to compete with other microorganisms in organic waste. Another aspect that makes fungi successful is the property to degrade a wide variety of the polymers that make up waste. They do so by releasing enzymes, similar to what is done in our digestive tract. Part of the enzymes that are secreted by mushroom forming fungi are unique. They are able to degrade lignin, which is a highly recalcitrant component of wood. By degrading lignin, nutritive sugars such as cellulose become accessible for other enzymes. The capacity to degrade waste so efficiently makes that fungi, mushroom forming fungi in particular, are at the basis of nutrient recycling in nature. Although we tend to dislike the view of spoiled food, it's a crucial aspect of life at our planet.

Fungi have been used by industry for more than a century to produce compounds of interest. Organic acids like citric acid are used to produce food and beverages, antibiotics to fight infections, and enzymes are used in industrial applications and for the production of food, feed, and drinks. The exhibition Fungal Futures shows a new application of fungi; the use of their mycelium as a material. Low value waste can be transformed into pure mycelium by letting the fungus degrade the substrate completely. By letting the fungus only partially degrade the organic substrate a composite material is created. In this case, the fungal hyphae bind the non-degraded organic material together.

By growing fungi on organic material we have created a palette of materials with rubber-like, plastic-like, paper-like, and wood-like properties. The structural and decorative properties of the mycelium such

as strength, elasticity, water repellency and colour are determined by the hyphal cell wall. The cell wall determines the shape of the hyphae and provides physical and chemical protection. Cell walls of fungi consist of fibrillar and matrix components. The composition of the cell wall, and consequently its properties, depends on the fungus and the environmental conditions such as temperature and substrate composition. Another way to change the properties of the mycelium is to inactivate genes involved in synthesis of one of the cell wall compounds by human intervention (a process called genetic modification). Fungi compensate absence of a matrix or fibrillar component by increasing the content of other cell wall polymers. As a result, a cell wall can be formed with different mechanical and decorative properties but that is still shaping the hyphae and is protective.

Our group has studied growth and development of fungi with the aim to improve fungi as a factory of enzymes or to improve mushroom production. The collaboration with artists and designers made us realize that our research is also relevant for the emerging field of mycelium based materials. By studying fungal growth we are able to select best performing fungi and to identify the optimal conditions to produce a material of interest. To this end, we need to understand why some fungi produce rigid mycelia, while others produce a more elastic mycelium; why some fungi can mechanically invade a certain type of wood, while others cannot; why some fungi grow extremely fast while others grow slowly. These questions are not only fundamental to understand the role of fungi in nature but also to produce high quality, sustainable materials that can be used in a wide array of applications.

I would like to thank Maurizio Montalti, Caroline de Roy, Aniela Hoitink, and Kristel Peters for inspiring our research group to think in ways we did not before. This research line would not have emerged without the invaluable input of the Microbiology group of Utrecht University and in particular of Kasia Lukasiewicz, Pauline Krijgsheld, and Freek Appels.

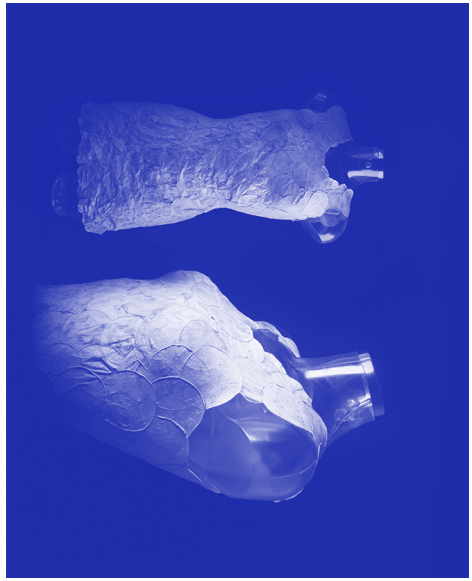
Han Wösten has a chair in Microbiology since 2001. He is head of the Biology Department of the Faculty of Science of Utrecht University and is the chairman of the Royal Dutch Society for Microbiology. Han Wösten was awarded the PIONIER grant 2001 (800 k€) and the STW Simon Stevin Meester prize 2008 (500 k€).
Together with Maurizio Montalti he won the Designers & Artists 4 Genomics Award DA4GA 2010 (25.000 €) with the project Systems Synthetics and together with Julia Kaisinger and Katharina Unger the BioArtDesign award 2012 (25.000 €) with the project Fungi Mutarium.
The latter was awarded the BraunPrize for Sustainability Award 2015.

Project:
MycoTEX /
Mycelium Textile

Artist:
Aniela Hoitink /
NEFFA

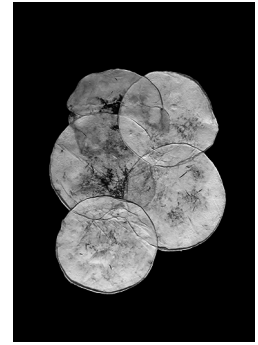
e: aniela@neffa.nl
w: www.neffa.nl

01.01
MycoTEX Corset / detail



01.04
MycoTEX / dress

01.03
MycoTEX / combining
mycelium and textile



01.02
MycoTEX / modular
elements

The world is dynamic.
However our textiles are not.
They have been with us all our lifetime, but they do not seem to have changed much. In fact, we actually require them to remain exactly the same for as long as possible. Nowadays our consumption rate is ever increasing and, as part of such disposable culture, we hardly repair anything. Aniela aims to change the way we use textiles. By altering or adding properties to textile she is investigating how we can and will use textiles in the future and what the related implications will be.
The initial purpose of MycoTEX was to create a textile out of living material and to learn how to develop a real garment out of it.
Aniela started by combining mycelium (and its peculiar properties) with textiles, in order to create flexible composite products.
Learning whilst researching, her goal turned into developing textiles consisting exclusively of pure mycelium.
Along the research process, Aniela developed a method for retaining flexibility without using traditional textile materials.

Aniela's inspiration comes from the observation of 'soft bodies' species. Such organisms grow by replicating themselves over and over again, following some sort of modular pattern.
This observation inspired Aniela to build the textile out of modules, a solution which consequently provided a number of relevant benefits.
Repair and replacement of the garment are in fact easy to perform and and do not interfere with the look of the fabric.
Furthermore, the garment can be built three-dimensionally and shaped whilst being made, fitting the wearer's wishes.
Thus, it is possible to create mycelium patterns, to adjust the length of the garment or for example to add elements.
This allows growth of just the right amount of needed material, eliminating every potential leftover / waste during the making process.
Aniela's explorations resulted in a dress with such qualities.
Once the garment is not in use anymore, it can easily be composted, allowing to completely rethink future possibilities for fashion items.

After she completed Fashion Design
at the Utrecht School of Arts,
Aniela worked for various fashion companies,
before launching NEFFA in 2004.
NEFFA is a Dutch acronym standing for
'net effe anders', or 'willing to do things
just that bit differently'.
Aniela believes that distinctiveness
and individuality in people and materials
are the elements that make
the world a special place.
Textile innovation, but just that
bit different, is what NEFFA is all about.
Through her multi and interdisciplinary
way of working and by altering or adding
properties to textile, she is investigating
how we can and how we will use textiles
in the future and what the related
implications will be.
Using technology and microbiology,
Aniela looks at textile as an extension
of the skin and she is on a quest
for improving / changing the properties
of traditional textile materials,
driven by the exploration
of their multifunctional layers.

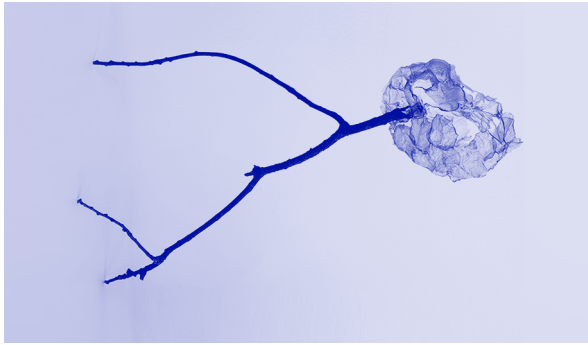
Project:
And Who Are You? /
A Quest For Transparent
Living Materials

Artist:
Caroline de Roy

e: mail@carolinederoy.nl
w: www.carolinederoy.nl

02.01
Mycelium mat composition / detail

02.03
Mycelium jewellery /
prototype



02.04
Mycelium anthropomorphic sculpture /
in progress

02.02
Mycelium mat & branches

The acquaintance with mycelium triggered the search for a new transparent biodegradable material that could be as strong and durable as traditional synthetics, while providing the chance to also easily and safely dispose it, when needed.
Researching transparency has led to working with a mutant type of mycelium - ΔSC3 - that does not form hyphae when grown as a floating mat, thus resulting in a transparent / translucent material.
Working with mycelium, a living organism, has proven to be quite delicate. The risk of contamination requires specific working conditions. The material itself, once grown, is rather brittle. Mixing it with kombucha (bacterial cellulose) seems to improve elasticity and firmness of the final material.
Combining it with spent flowers also provides interesting results. The resulting mycelium samples bear a strong resemblance to skin, both in structure and in range of colour, offering an exciting feature for the creation of anthropomorphic sculptures: tree branches supporting a hollow body of different mycelia.

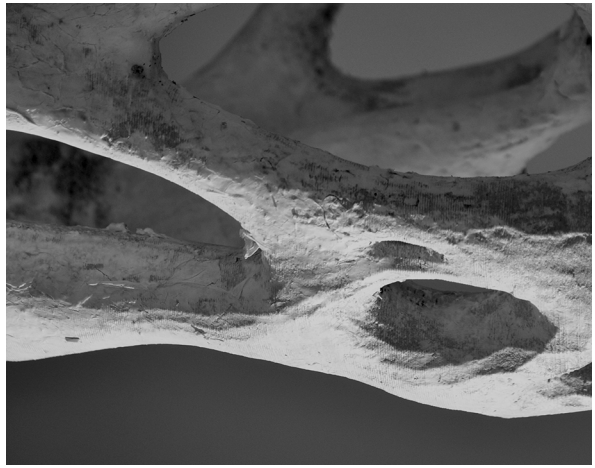
Ongoing research will tackle the physical properties of the material as well as its durability. Furthermore, the whole cycle of growth and decay characterising mycelium materials is a very relevant aspect that triggers Caroline's investigation, as her opinion is that no thing should last forever.
The possibilities of moulding the world to one's wishes seem to be endless and human resourcefulness looks infinite, thus resulting in borders being pushed further.
Within such framework, Caroline's present use of a specific genetically modified type of mycelium is highly fascinating as the material does not only deliver the transparency sought for, but it also raises an extra dimension to her philosophical quest: 'Who are we?'

Caroline de Roy is a visual artist
based in Amsterdam, graduated from
Rietveld Academy. Caroline's work is driven by
reflections based on the fact that an individual
cannot choose where and how it is born
nor choose its mental or physical state:
one has to deal with its
(in-)abilities and cope with life.

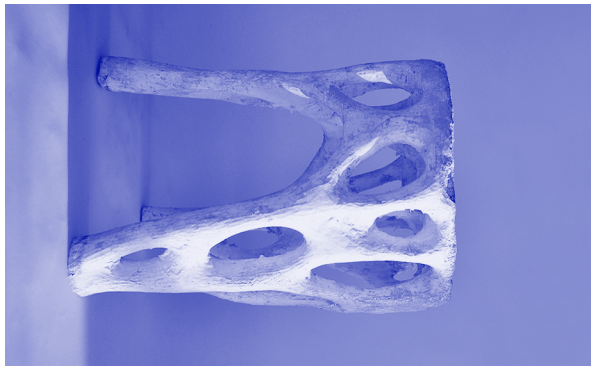
Project:
Veiled Lady 2.0

Artist:
Studio Eric Klarenbeek

e: info@ericklarenbeek.com
w: www.ericklarenbeek.com



03.01
Veiled Lady 2.0



03.04
Veiled Lady 2.0

03.03
Growing stages / scale models

03.02
Mycelium Chair / process samples

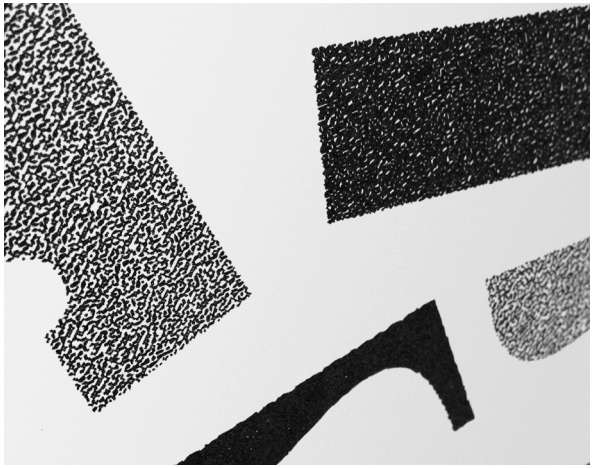
In cooperation with scientists, makers and 3D printing manufacturers, Studio Eric Klarenbeek developed a fully automated production method for 3D printing living mycelium. Mycelium is utilised as a binder for organic waste, a potential infinite and environmentally friendly living glue, to create and replace products which are currently made out of plastics, wood, etc.
Implementing growth as part of the studio's production processes and using local raw plant material combined with living matter, enable the studio to identify possibilities for local, renewable and circular production and to reflect on a radical new view regarding decentralised manufacturing. This allows the creation of products with a negative CO2 footprint.
We're currently imprisoned in a chain of waste, both in material fabrication as well as in regard to the negative effects on our surroundings, due to transportation of raw materials and goods.
3D printing seems to partly provide a solution, since it allows producing locally, by connecting nearby 'Makers' through rapidly growing web portals (e.g. 3D hubs). However, the main obstacle we have to overcome lies in the applied materials.
Even for 3D printing there are little sustainable alternatives available. Resources, both natural and synthetic, are transported worldwide and the greenest variants (e.g. bioplastics) can increase pressure on agriculture and food production and are partly deriving from genetically modified sources.
Printing mycelium triggers the opposite effect: the plant material produces oxygen during its lifecycle and it eliminates the necessity of heating materials in the printing process, thus reducing the use of energy.
Instead of wasting less,
The studio's work strives to absorb emissions, and when the product reaches the end of its cycle it's fully compostable and it can be disposed without harming the environment; on the contrary, it will fertilise its surroundings.

Together with Maartje Dros, Eric Klarenbeek forms a designers duo concentrating on public space & technology. Their aim is to challenge and explore the use of space by connecting history, crafts and new technologies in archetypical and recognisable objects, to invite and evoke new use of space.
Eric Klarenbeek graduated in 2003 at the Design Academy Eindhoven. Since then he has designed for clients such as Droog, Moooi, Eneco and the Dutch Ministry. Besides that he's founder of the ArTechLab at the ArtEZ art academy. His projects have been exhibited and published extensively. His 'Windlight' has been presented at the World Expo 2010 in Shanghai and 'The Floating Light Project' was awarded for innovative design at the Design Academy Eindhoven.
'My work is characterised by interaction and innovation. My products can be in motion, react on our emotions or respond to developments in our society. I search for new meaning and principles in objects, for unexplored connections between materials, production methods, makers and users. Every project is a research, resulting in interior and public space appliances and designs.'

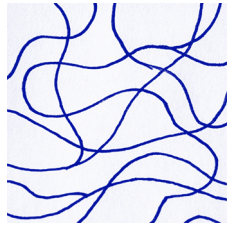
Project:
Fungal Futures /
Identity

Artist:
Francesco Zorzi /
NO-ROCKET

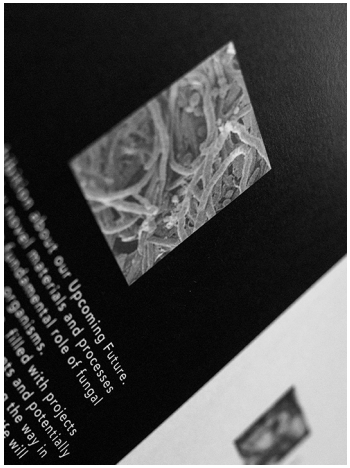
e: hello@no-rocket.com
w: www.no-rocket.com



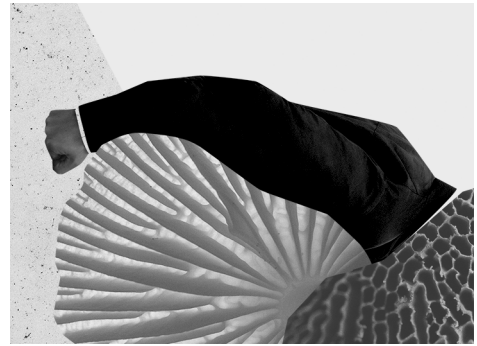
04.01
Hyphae mesh grid / pattern detail



04.03
Hyphae mesh grid /
initial sketch



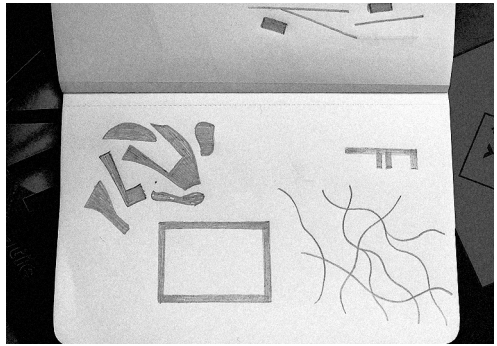
04.04
Hyphae mesh grid /
SEM mycroscopic view



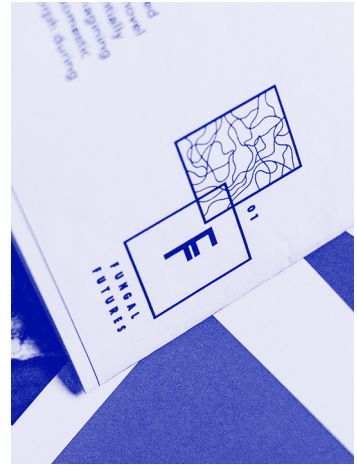
04.04
Human-Fungi collage /detail

Fungal Futures / Identity is designed as a graphic system to better understand the collection of projects displayed at the exhibition FUNGAL FUTURES / Growing Domestic Bio - Landscapes.
Since the first stages of its process, the project develops as a real 'tool' for interpreting and understanding the meaning of the exhibition itself.
The interest of Francesco Zorzi lies in the junction between 'exhibition, objects and people', going beyond the logic that hides behind the concept of a 'show' when merely intended as a physical place in which a diverse mix of people share part of who they are and what they do.
Considering the graphic design of this exhibition more than just a way to simplify and ease the comprehension of its content, Francesco developed his work as a tool for both describing and inspecting it, searching for a way to visually enhance the logic that connects the artists.
What does really pool together this extravagant and diverse combination of people and backgrounds, besides the common ground of their research?

Francesco started by analysing mycelium, the structure characterising fungal growth; while diving into the mechanisms animating its growing process he noticed interesting similarities with the exhibition itself.
As the mycelium develops, nourished by the degradation of organic substrates - such as lignin, cellulose and other materials working as nutrients for its growth - the intricate mesh of its hyphae (the long branching, filamentous structural cells of a fungus) acts as a powerful glue holding together the different elements of the 'substrates', contributing to the formation and the development of the fruiting bodies (mushrooms).
Along the same line, the artists on show and their works can also be considered 'substrates' for the exhibition itself.
The scattered particles of the projects on show at FUNGAL FUTURES are bound to each other by the topic and the framework of the exhibition; however, the variety of the artist's backgrounds and the richness of their personal researches are to be considered as the 'real nourishment' for the exhibition, as the support for



04.06
Logo & graphic elements / initial sketches



04.05
Monogram logo & graphic
mycelial grid

its growth and as that special chemical bond transforming its primordial nature and filling it with new possibilities.
Francesco used illustrations and graphics as multilayered visual metaphors to illustrates the parallelism between mycelial behaviour and the mycelium-related projects displayed at FUNGAL FUTURES, offering insights in relation to the structural properties of fungal mycelia (generally exclusively known for their fruiting bodies).
Deriving from such analysis and reflections, the logo becomes a combination of a monogram and graphics.
The monogram holds the two 'F' of FUNGAL FUTURES and it is enclosed into a rectangular shape; a cross reference to the elements of the Mendeleev periodic table, suggesting the high potential and the opportunities arising from the creation of a whole new set of mycelium-based materials.
The graphic acts as a dynamic grid, letting the mycelium hyphae change profoundly the core (and the nature) of the monogram, while interacting with it.
By intersecting and decomposing the monogram, while scattering its parts in an ever-changing combination of elements, the mycelium gives life to a dynamic set of novel possibilities and scenarios.
A new greater 'whole' more meaningful than just the sum of its parts.

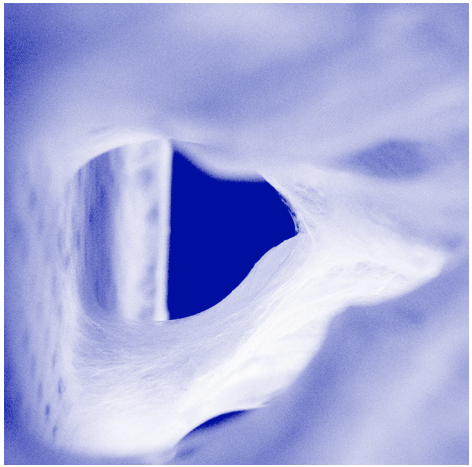
Francesco Zorzi is an Italian
visual designer and illustrator,
working and living in Amsterdam.
Graduated with a MA in Product Design
at the Politecnico School of Design in Milan,
Francesco moved to The Netherlands
in 2012 to work for the
Italian designers duo Formafantasma.
In 2015 he launched NO-ROCKET,
a multidisciplinary creative studio
in love with materials and the tactility of things.
Constantly on the edge between objects
and images, design and illustration.
NO-ROCKET finds inspiration in the
intersections between disciplines,
creating a fresh visual work
distinguished by a strong 'hands-on' imprint.
Experimenting with graphic design, illustration
and materials as 'tools' for visual storytelling,
NO-ROCKET prefers pencils to keyboards,
paint to colour palettes,
paper and scissors
to copy-paste.

Project:
Mycelium Tectonics

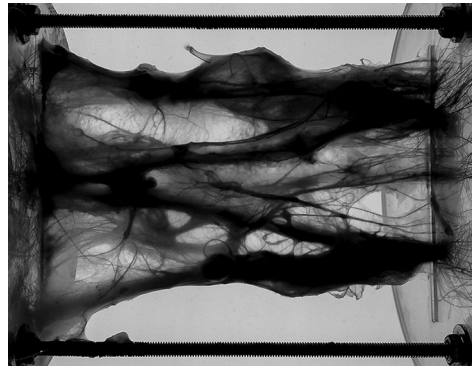
Artist:
Gianluca Tabellini

e: gianluca.tabellini@gmail.com
w: mycelium-tectonics.com

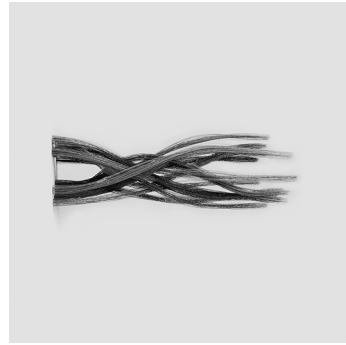
05.01
Mycelium column / detail



05.04
Final self-standing model / base detail



05.03
Hemp structure / density gradient



05.02
Final model simulation

It's a longstanding practice to refer to nature as an (eco-)system governed by non-linear interaction logic among its various elements. In such perspective, growth and development processes, common to all organisms, allow to unravel characters of increasing complexity that attribute quality and performance at a global level, unseen in the constituent subsystems.
This concept can be extended to architecture, where attention is placed on how a process develops as well as on the rules that guide design and planning. The adaptive behaviours of mycelium offer an inspiring model for architecture, in favour of a complex system whose functionality is not only the sum of single component's performances, but rather the result of the interaction between parts and their reciprocal self-organisation in space.
These explorations of matter aim to describe a new kind of tectonics, where variation and differentiation of the system are intrinsic proprieties of the system itself, while capable of revealing highly aesthetichal organisation.

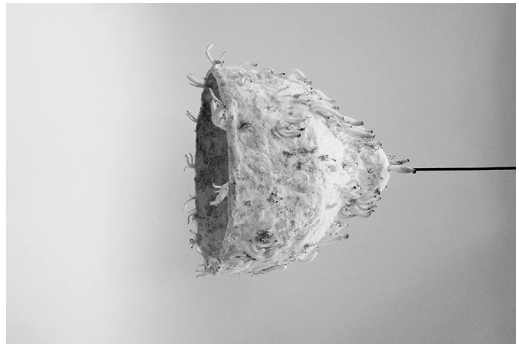
Gianluca Tabellini is an Italian architect and engineer graduated from the faculty of Building Engineering and Architecture, University of Bologna.
During his academic path, he worked on several architectural projects shown in Italy, Greece and Brazil. For 8 months he joined the Mario Cucinella Architects firm in Bologna.
Fascinated by technology and nature, Gianluca has developed a real passion for computational design and the investigation of complex systems.
He embraces the digital culture not only through the analysis of complex structures and parametric optimisation, but also through designing with self-organisation processes and swarm-intelligence simulations.
An enthusiast of nature, IT, cycling and digital fabrication, he is also a co-founder of MakeInBo Bologna's Fablab.
Gianluca is currently based in Zurich where he joined 'designtoproduction', a consultancy for complex timber structure and CAD-CAM optimisation.

Project:
MYX

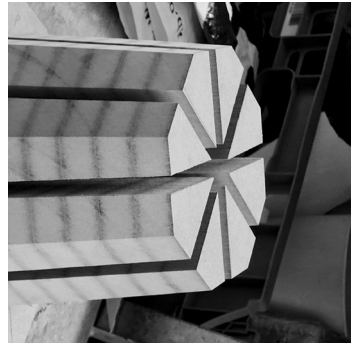
Artist:
Jonas Edvard

e: jonasedvard@gmail.com
w: www.jonasedvard.dk

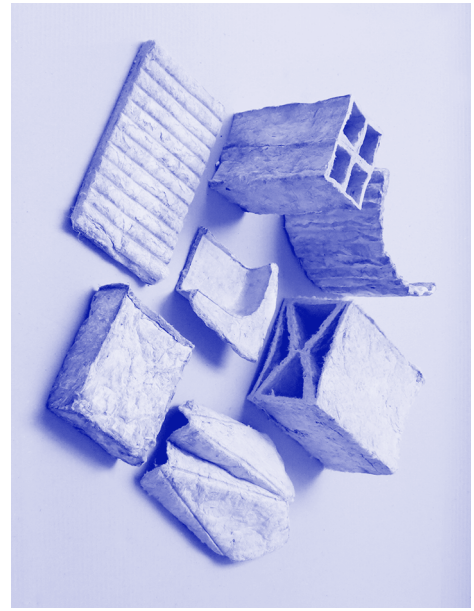
06.01
MYX material samples / detail



06.04
MYX hanging lamp



06.03
MYX stool / mould



06.02
MYX material samples

The MYX project focuses on a new material developed from fungal mycelium and natural plant fibres, which are a byproduct of agricultural production. The project is to be seen as both a food and design production - utilising waste as resource for creating food for humans while upcycling waste to become a design object and a product with functional qualities.
The first outcome of the MYX project was a lamp designed in 2013. By creating the MYX stool, Jonas Edvard continues to explore and create objects which can define the future aspects of sustainable design through the research into mycelium based manufacturing.
The material developed for this project relies on local resources - sourced directly from the local area of Copenhagen, Denmark, where Jonas Edvard works and lives. The living material is recycled from an Oyster mushroom producer using organic substrate for creating gourmet mushrooms.
Leftover materials are then mixed in layers with the pasteurised hemp fibre creating a laminated composite which after three weeks delivers fresh mushrooms.
After food production the material is moulded in shape and dried out to become a functional product, fully biodegradable and sustainable.
The exhibited objects from the MYX project focus on the structural qualities of a non-woven mycelium composite textile. As part of such framework, the MYX stool and the objects on show are composed of multiple layers of organic hemp fibres grown and moulded into shape.
The fungal mycelium acts as a matrix binding together the fibres to render a strong, flexible and lightweight material.
The production technique gives life to a new possibility in regard to the shaping of mycelium-based products.
The new material is grown and moulded in two different steps, allowing to create complex constructions by turning hemp fibre into a strong organic fibre's composite material.

Jonas Edvard

Jonas Edvard is a young Danish designer working and living in Copenhagen, Denmark. He graduated from the Royal Danish Academy, School of Design in 2013 with a MA in product design.
Approaching the design process as an alchemist, Edvard experiments with natural resources and creates products focused on the perception of the material, allowing to place objects in a new context.
With a renewed focus on the aesthetic value and on the functionality of raw materials, Jonas Edvard explores new possibilities in sustainable design.

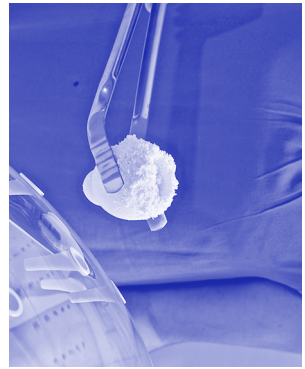
Project:
Fungi Mutuarium /
Growing Food
On Toxic Waste

Artist:
Katharina Unger &
Julia Kaisinger /
Studio LIVIN

e: contact@livinstudio.com
w: www.livinstudio.com

07.01
Fungi Mutuarium / detail

07.04
Fungi Mutuarium / edible FU



07.03
Fungi Mutuarium / harvest

07.02
Fungi Mutuarium & FUs

LIVIN Studio, in direct collaboration with Utrecht University, has developed a novel fungal food product grown on (plastic) waste, cultivated by utilising a prototype for growing, as well as culinary tools to eat it.
LIVIN Studio strongly believes that food production needs to be revolutionised and more technologies are needed to farm under extreme environmental conditions. Scientific research has shown that fungi can degrade toxic and persistent waste materials such as plastics, converting them into edible fungal biomass.
LIVIN Studio started working with fungi, such as Schizophyllum commune and Pleurotus ostreatus. Those species are found throughout the world and can be seen on a wide range of timbers and many other plant-based substrates virtually anywhere in Europe, Asia, Africa, the Americas and Australia.
Next to the property of digesting toxic waste materials, they are also commonly eaten.
As fungi break down the plastic ingredients without storing them in their bodies, like they do with (heavy) metals, they can be edible.
Fungi Mutarium is a prototype that grows edible fungal biomass, mainly mycelium, as a novel food product. Fungi are cultivated on specifically designed agar shapes that the designers defined as 'FU'.
Agar is a seaweed-based gelatine substitute and, when mixed with starch and sugar, acts as a nutrient base for the fungi. The 'FUs' are filled with plastics. The fungal culture is then transferred, digesting the plastic and overgrowing the whole substrate. The shape of the 'FU' is designed in order to hold the plastic and to offer fungi a large surface to grow on. The 'FU's' shape has been developed inspired by mushrooms and by other natural organisms.
Therefore, when harvesting the 'FUs', the user is invited to an experience similar to the one of harvesting mushrooms in the wild. Fungi Mutarium is a conceptual device that presents ongoing research and it is currently not a commercially available product.

LIVIN is a collaborative design
development office, based in Austria.
LIVIN was established by industrial designer
Katharina Unger and it is recently working
in collaboration with Vienna designer
and maker Julia Kaisinger.
LIVIN is inventors, innovators, designers,
culinary artists and scientists.
Their skills match a wide variety of creative
tasks, however their greatest passion
is to bring people closer to the origins
of their food through design.
They prefer to work in a space where nature
and design meet, where humans interact
with their living environments and
where current means and methods
of production interweave with natural systems.
They believe that design can impact agriculture
and, as a result, our food and food cultures.
The right tools and technologies, applied
and made usable by excellent design,
can impact the materiality of our food.

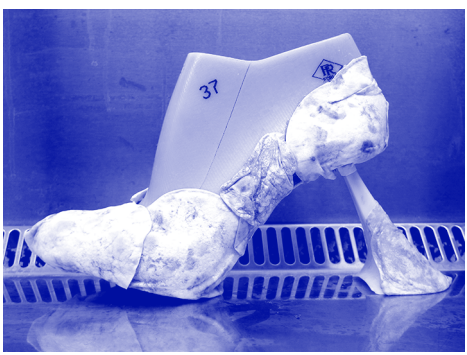
Project:
Growing Shoes

Artist:
Kristel Peters /
COJAK

e: kristel.peters@cojak.be
w: www.shoedesigner.be

08.01
Mycelium on hemp / shoe detail

08.02
Growing Shoes / lab process



08.03
Growing Shoes / early prototype

With her project 'Rethinking High Fashion Shoes' Kristel Peters explores innovative methods and possibilities for shoemaking. She aims to trigger both the Fashion and the shoe industry to design future products, within the concept of circular economy.
Shoes have a large environmental impact; every year we produce 21.000.000.000 pair of shoes worldwide and 95% of those ends up in the landfill. Such massive production of shoes is linked with high CO2 emissions, enormous water consumption and the use of highly toxic products.
A vast shift towards sustainability is a must. Yet, most fashion houses tend to focus on formal developments, rather than on process and material innovation, giving sustainable solutions the cold shoulder. To research on such subject and in order to identify valuable alternatives, Kristel developed the project 'Alice, A Zero Waste Fashion Shoe'. In collaboration with sustainability experts and thanks to the conducted research, she identified three important guidelines to follow for designing zero waste shoes:

1. The design of the shoe should be modular and ready made for disassembly and reduce the components of a shoe vastly.
2. The materialisation of the shoe must be zero waste.
3. The shoe is to be looked at as a service, not as a product.

Following this methodology she designed 'Alice', a new modular shoe. 'Alice' consists of two detachable parts: the base and the upper. The base is a modular shoe structure, produced through additive manufacturing.
The upper is replaceable and it consists of 'zero waste' materials. The full shoe can be adapted and customised according to the needs and / or the trends. Thanks to its modular qualities, the shoe is fully recyclable.
What if we could grow our shoes? The search for 'zero waste' materials has led Kristel to explore the world of bio-based materials. The texture and the beauty of the growth process of mycelium-materials triggered Kristel's curiosity. Mycelium is a natural, self-assembling material, capable of turning waste into a strong polymer, which can be then shaped into moulds.

08.04
Growing Shoes / samples

08.05
Growing Shoes / upper & heel

At the end of its life the material can be returned harmlessly to nature. Other properties, such as for instance water repellency and elasticity, are interesting qualities for implementing mycelium materials in shoes, particularly when looking at the potential replacement of animal leather traditionally used in the shoe industry. By growing materials exclusively developed for designing and producing shoes, the designer avoids to take part in the whole cycle consisting of animal feeding, slaughtering, wasting energy, tanning, creating waste. 'We are breeding animals for their meat but also for their skins, so growing materials is certainly not something new for humans; we have always been doing it. What if we would bio-fabricate our shoes (uppers) out of mycelium? How would that work? Can I, as a designer, lead this process and shape it into shoes? Can the result be as desirable when compared to traditional leather shoes?'
Growing Shoes shows the results of experiments carried out by employing mycelium for shaping shoe parts, both as solid and hollow shapes. The resulting solid shapes are implemented as heels, platforms and insoles of the shoe. In order to grow such shapes, different waste streams such as coffee grounds and sawdust are used as substrates. The hollow shapes are grown as pure materials on liquid media or on fibres such as hemp and psyllium, providing additional features in relation to strength and structures.
Once harvested, the pure mycelium can be manipulated as a clay-like material, which is then used to cover some parts of the heels or that can alternatively be moulded by using lasts.

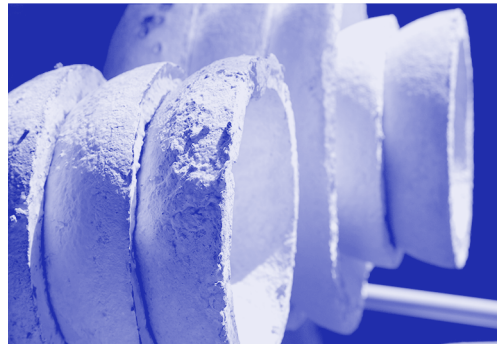
Kristel Peters is a shoe designer
with more then fifteen years experience
in the international Fashion Industry
(e.g. Dries Van Noten and Bottega Veneta).
Currently she is involved in KASK /
School of Arts of Hogent as artistic researcher,
where she is working on the project
'Rethinking High Fashion Shoes',
funded by the research fund arts
of University College Ghent.
As part of this project, Kristel is exploring
possibilities for the development of
sustainable shoe design.
By focusing on circular economy models,
she is particularly interested in and in search
for sustainable methods for shoemaking and
for new materials with low / no impact.
Her work is a combination of craftsmanship,
experiments with bio-materials
and state-of-art technology.
Kristel's project 'Alice' has been recently
selected as 'Laureate' of the first
Additive Design Challenge.

Project:
The Growing Lab /
Mycelia

Artist:
Maurizio Montalti /
OFFICINA CORPUSCOLI

e: info@corpuscoli.com
w: www.corpuscoli.com

09.01
Pure mycelium flex rubber / detail



09.03
Mycelium bowls and plates

09.04
Pure mycelium flex rubber

09.02
Mycelium tiles stack

The Growing Lab / Mycelia consists of an ongoing, process-based research and exploration actively engaging with investigating and assessing methodologies for the implementation of fungal mycelium, as a main agent for the development of novel materials, production methodologies and of the related deriving applications in the field of design and beyond.
The project tackles a particularly relevant and urgent issue characterising collective communities worldwide: waste generation and environmental impact originated by oil-based plastic compounds, particularly when embedded in disposable applications and / or products.
The Growing Lab looks at the possibility of valuing existing organic waste streams (substrates) by transforming low value products into a vast range of novel matters, each characterised by diverse qualities and suitable for different applications. Within such context, The Growing Lab purposes a radical paradigm shift, offering a different insight into the objects occupying our everyday life and the materials they consist of.
By moving beyond traditional production methods, a new universe of 'cultivated' objects starts to emerge.
This allows generating novel and tangible narratives, aiming to actively develop research, solutions and novel perspectives and visions in relation to the constitution of new reliable and varied materials and of the consequently deriving products and systems, contributing to balancing the role of the individual with the ecosystem he's part of. The resulting structural and decorative materials are highly interesting for the development of applications relating to the fields of design and architecture. By materialising new processes and products characterising our everyday life (i.e. Mycelia collection), The Growing Lab tangibly demonstrates how traditional synthetic, toxic materials (e.g. plastics), could be replaced with novel, 100% natural, fully compostable mycelium-based matters.
Rooted in the described background, The Growing

09.05
Mycelium wheel

09.06
Mycelium vessels overview

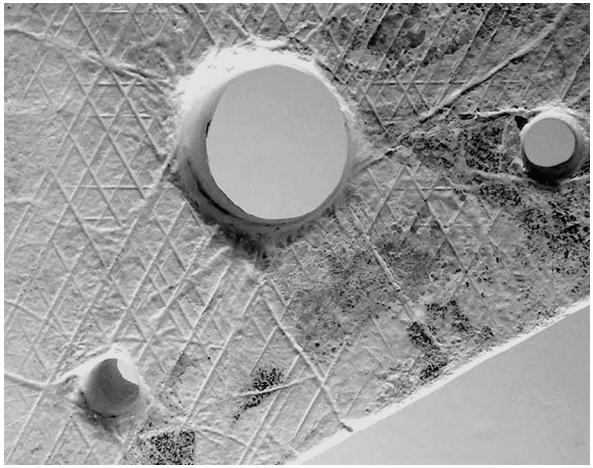
Lab / Mycelia introduces a collection of everyday objects, materialised through growth and aiming to effectively communicate a tangible vision about the way materials will change in the future (i.e. biotechnological revolution) and about the way manufacturing processes and techniques will modify accordingly.
Within this framework, The Growing Lab indicates unprecedented paths regarding the generation of better and economically sustainable production possibilities, transforming current existing paradigms, systems and networks, and suggesting a shift from the traditional concept of industrial production towards an innovative model, rooted in cultivation.
The project's ultimate ambition is the one of stimulating the industry's attention, with the objective of bridging the existing gap between design-driven research projects and the industry itself, for the creation of a real positive impact that new mycelium-based materials and products could bring about.

Officina Corpuscoli (OC), founded by
Maurizio Montalti in 2010,
is an Amsterdam based transdisciplinary
design practice, seeking to reveal
unorthodox relationships among
existing paradigms.
By distilling research and analysis
and materialising relevant facts,
OC's goal is to create conditions that allow
for a resonant critical experience,
by the synthesis of ideas through design.
Officina Corpuscoli actively engages in
collaborating with professionals from
other disciplines, while providing creative
consultancy and developing commissioned
and self-initiated projects,
mostly inspired by and in direct collaboration
with living systems and organisms.
The studio's work has been widely shown
in multiple museums, exhibitions and festivals,
both nationally and internationally.
Besides the various activities and projects at OC,
Maurizio is the co-founder of Mycoplast,
a company focused on industrial scale-up of
mycelium based materials, services and product
and he is also highly involved in education,
currently heading the MAD Master
at Sandberg Instituut, as well as teaching,
lecturing and mentoring in different national
and international academies and universities.

Project:
Polyominoes &
Maritime Fungi

Artist:
Phil Ross

e: mephilross@gmail.com
w: www.mycoworks.com



10.01
Maritime fungi / detail

10.04
Fungal polyominoes / assembled

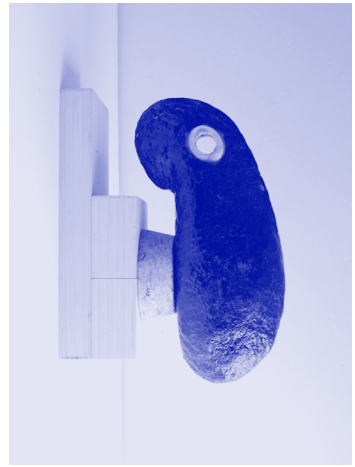
10.03
Fungal polyominoes

10.02
Maritime fungi /
prototypes

Polyominoes /

Fungal polyominoes are a small alphabet of bricks that are grown from mycelium and can be arranged into almost any space-filling configuration. Mycelium has the natural ability to fuse together smaller pieces of organic material into a greater whole, with analogous qualities to petroleum based open and closed cell foam. Artefacts that are made from living mycelium will bind together in as short as one day if placed in contact with one another, forming an organic weld that permanently joins two objects together.
After fusion the fungal objects are dried out and baked to kill the organism and stop its growth. Fungal polyominoe systems can be grown with diminishing and escalating factors of scale, much like the resolution of digital forms.

Similar to laminates and material printers, mycelium can take form through an additive manner, but with n-degrees of freedom for assembly. This polyominoe set features press-fit receivers for standardised lumber.

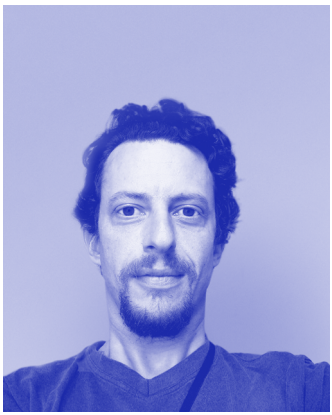


10.04
Maritime fungi / tadpole

10.05
Maritime Fungi / boat

Maritime Fungi /

Mycelium based biomaterials have qualities that are of interest towards maritime applications.
Mycelium can be grown with engineered densities and airspaces, which means that their buoyancy can be controlled.
The biomaterials can be grown on all organic inputs to resemble the performance of styrofoam and other plastics that are used in various water based industries.
Mycelium can be generated from local species and feedstocks, which means that artefacts might be introduced into sensitive areas where plastic is prohibited.
The timing and rate of degradation can also be engineered into the materials. Thus, mycelium artefacts can be used as a technology in bioremediation, landscape engineering, and for remote environmental probes that can be released without need for return.
The designs represented here are from some initial experiments MycoWorks has been conducting. One is based on the profile and form of boat, and the other is taken from the shape of a tadpole (a baby frog that looks like a fish).
The boat shape is covered in tree resin, and the tadpole with latex rubber.

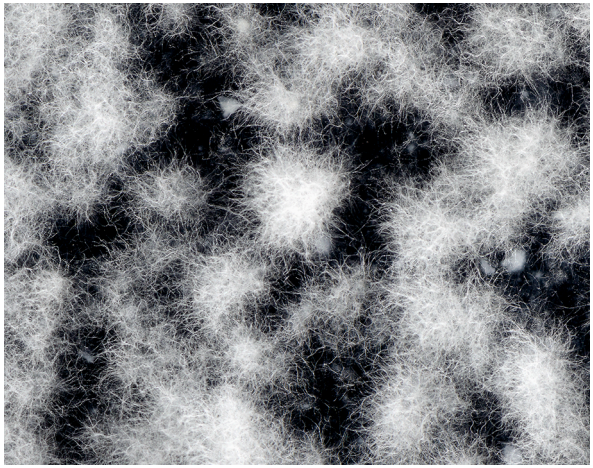


Philip Ross is an artist, inventor, and scholar whose internationally awarded and exhibited research is focused on biomaterial design and life support technologies. A thought leader on biomimicry, Philip's innovations in mycelium engineering are globally recognised as foundational to the invention of mycotecture, the practice of building with mycelium. His work has recently been showcased by the New York Museum of Modern Art, the Los Angeles County Museum of Art, Carnegie Mellon University, Silicon Valley's Zero1, the Moscow Biennale, and Germany's Kunsthalle Düsseldorf. In 2013, his mycelium-based furniture won Ars Electronica's Award of Distinction for Hybrid Art. Philip is a Visiting Scholar at Stanford University's Department of Bioengineering, and he is the CTO and co-founder of MycoWorks, which creates mycelium based biomaterials. His publications include 'Mycology Matrix Composites' (American Society for Composites, 2013), and 'Building from Waste' (Future Cities Laboratory Singapore / ETH Zurich).

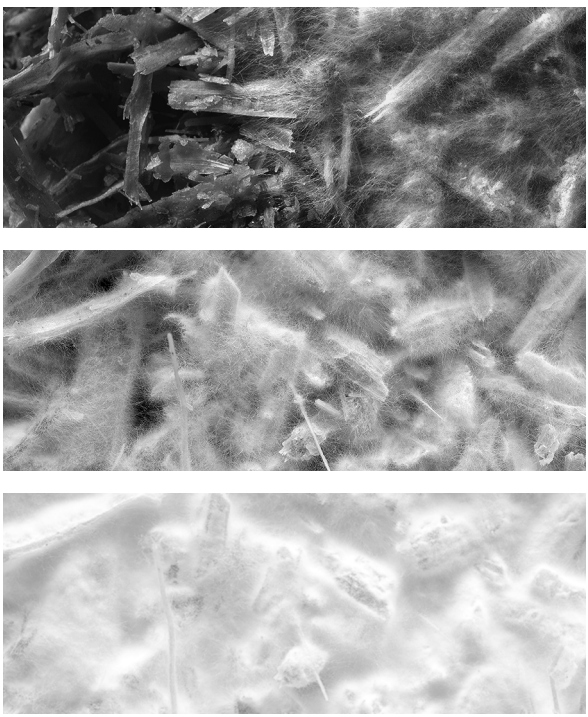
Project:
One Day /
Four Seconds

Artist:
Wim van Egmond

e: egmond@tip.nl
w: www.micropolitan.org



11.01
Schizophyllum landscape / detail



11.02
Mycelium on straw /
growth steps

One of Wim's main interests is in the portraying of small organisms and other microscopic subjects. He has always preferred to make photographs that are not just depictions of familiar objects, mainly in order to emphasise the formal photographic aspects as well. Since microorganisms are such unknown subjects the microscopic world already comes with a built-in abstraction, so to speak. When he started working as an artist he transformed reality in order to create abstract images. Nowadays he works as a pure realist but the images look more abstract than ever.

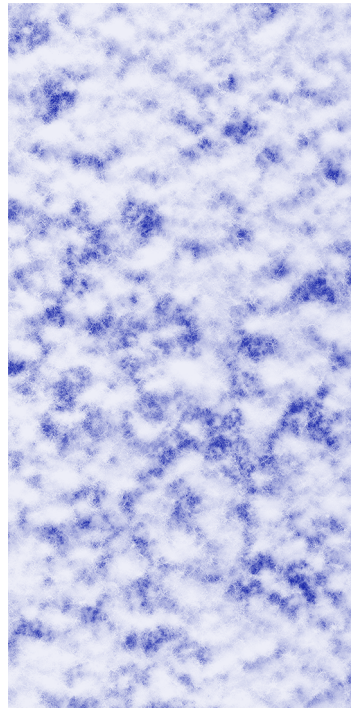
Wim van Egmond has realised mycelium growth time-lapse movies of the same fungal species which have been mostly employed by the various artists which are part of the exhibition FUNGAL FUTURES.

The movies were recorded by shooting one image every 14.4 minutes. Once speeded up to a 25 frames per second in the movie, this means that one day becomes compressed in 4 seconds. Wim also took some time-lapse shots through the microscope, so that the individual hyphae and the micro-landscapes could become more accessible while being clearly perceivable with the naked eye.

Since he practises several different photographic techniques, Wim is sometimes asked to do commissioned work, for example the stereoscopic photography of Cloaca, the artificial intestine machine of Belgian artist Wim Delvoye. From 2008 to 2014 he has worked on the Amsterdam museum for microbes, Micropia. He helped developing content, a visitor friendly microscope set up and he produced images and films.

Wim's work is somewhat related to Victorian traditions of microscopic slide making and the work of the 19th century naturalists. He is also inspired by Anthony van Leeuwenhoek, who discovered the micro world. He is currently researching his discovery of microbes.

His various web pages, like the on-line Micropolitan Museum have inspired many people to start looking through a microscope. Wim sometimes presents his images in an alternative context. An example of this is the



11.04
Schizophyllum colony / detail

11.03
Schizophyllum feeding
on nutrient plate

Microbial Art Climatology project, a revolutionary new scientific method to qualify the value of artworks by means of microscopic organisms.
Since 2006 Wim has worked on a series of autonomous photographs called Magnified Landscapes. He uses multiple images to create large format composite photographs.
Small parts of a landscape are captured in extreme detail so the smallest elements are microscopic and single cells can be seen. The combination of complexity and detail results in an image that can't be overseen in one instant.
Wim's most recent projects involve time-lapse movies of microbes and fungi. By combining focus layers it is possible to create images and movies with extreme detail and infinite focus.

Because of this we loose our sense of scale.
In extreme close up the colonies of fungi become strange tapestries or huge forests.
We can roam these microscopic fungal landscapes as explorers of an unknown world, a habitat that is actually not more than a bit of dark mold in a corner of the wall of our kitchen.

Science has always fascinated Wim
and his work has a certain affinity with it.
Photography is an unusual mixture of technique
and perception: the camera acts as a surrogate eye,
a mechanical observation device
that enables us to capture an image.
Wim is particularly interested in those areas
where photography deviates
from human perception.
This is one of the reasons why he has made
a study of optical techniques that can be used
to increase the scope of our perception.
Wim has specialised in photography through
the microscope and in stereoscopy
and a combination of both.
The past years he has also started filming
and making time-lapse movies.
Primarily he works as an independent artist,
but since his work brings together both art
and science, a part of his work
is used as scientific illustration.
Regarding the artistic aspects of his work,
Wim thrives for tranquility in his images;
the compositions are carefully balanced.
This resembles the accuracy of a scientific approach.
But there is often a hint of absurdism
in what he makes. In order to find subjects
that have a wide variety of form and colour,
Wim explores different habitats.

This book has been produced in line with the exhibition
FUNGAL FUTURES /
Growing Domestic
Bio - Landscapes
representing the first chapter of an evolving project, exploring a wide range of possibilities for utilising mycelium, both as a medium and as a matter.

This first exhibition took place at Universiteitsmuseum Utrecht (March 23 - May 16, 2016).

Commissioned by:
Utrecht University /
MICROBIOLOGY
Prof. Han Wösten

Curated, designed & produced by:
Maurizio Montalti /
OFFICINA CORPUSCOLI

Graphic design & illustrations by:
Francesco Zorzi /
NO-ROCKET

Universiteits
Museum Utrecht

kfHein,fonds

STW
connecting innovators

Gemeente Utrecht

Universiteit Utrecht

NWO
Netherlands Organisation for Scientific Research

FUNGAL FUTURES
exhibition is made possible
thanks to the generous
support of:

CNC Exotic Mushroom /
Gemeente Utrecht /
KF Hein Fonds /
NWO /
STW /
Universiteitsmuseum Utrecht /
Universiteit Utrecht /

CNC EXOTIC MUSHROOMS

MycoTEX /
Mycelium Textile
Photo Credits:
01.01, 01.04: © Robin du Maine
01.02, 01.03: © NEFFA
Objects Credits: NEFFA

And Who Are You? /
A Quest For Transparent Living Material
Photo credits:
02.01 - 02.04 © Caroline de Roy
Objects Credits: Caroline de Roy

Veiled Lady 2.0 /
Photo Credits:
Portrait © Mike Roelofs
03.02 © Benjamin Orgis
03.01, 03.03, 03.04 © Studio Eric Klarenbeek
Objects Credits: Studio Eric Klarenbeek

Fungal Futures /
Identity
Photo Credits
04.01 - 04.06 © Francesco Zorzi / NO-ROCKET

Mycelium Tectonics /
Photo Credits:
05.01 - 05.04 © Gianluca Tabellini
Objects Credits: Gianluca Tabellini
Project Advisor: Prof. Alessio Erioli
(University of Bologna, Faculty of Engineering - DA / Co-de-iT)
Project Co-Advisors: Prof. Alessandra Zambonelli
(University of Bologna, DIPSA),
Maurizio Montalti (Officina Corpuscoli),
Philip Ross (Mycoworks)

MYX /
Photo Credits:
06.01 - 06.04 © Jonas Edvard
Objects Credits: Jonas Edvard

Fungi Mutuarium /
Growing Food On Toxic Waste
Photo Credits:
07.01 - 07.04 © Paris Tsitsos
Objects Credits: LIVIN Studio
Research Partner: Utrecht University - Department of Biology,
(Prof. Dr. Han Wösten, MSc Kasia Lukasiewicz)

Growing Shoes /
Photo Credits:
08.01, 08.02, 08.03 © Filip Bullens / COJAK
08.04, 08,05 © Caroline Vincart
Objects Credits: Kristel Peters

The Growing Lab /
Mycelia
Photo Credits:
09.01 - 09.06 ©Maurizio Montalti /
OFFICINA CORPUSCOLI
Objects Credits: OFFICINA CORPUSCOLI

Polyominoes & Maritime Fungi /
Photo Credits:
10.01 - 10.06 ©Phil Ross
Objects Credits: MycoWorks

One Day / Four Seconds
Photo Credits:
11.01 - 11.06 ©Wim van Egmond