

Mycoremediation



Sandra Tuszynska (PhD)

Paul Stamets – *“The path to the future, is the path of the mycelium.”*



“I know some of my hypotheses sound rather extraordinary. I may be a little weird, but I’d rather be weird and right than normal and wrong.”

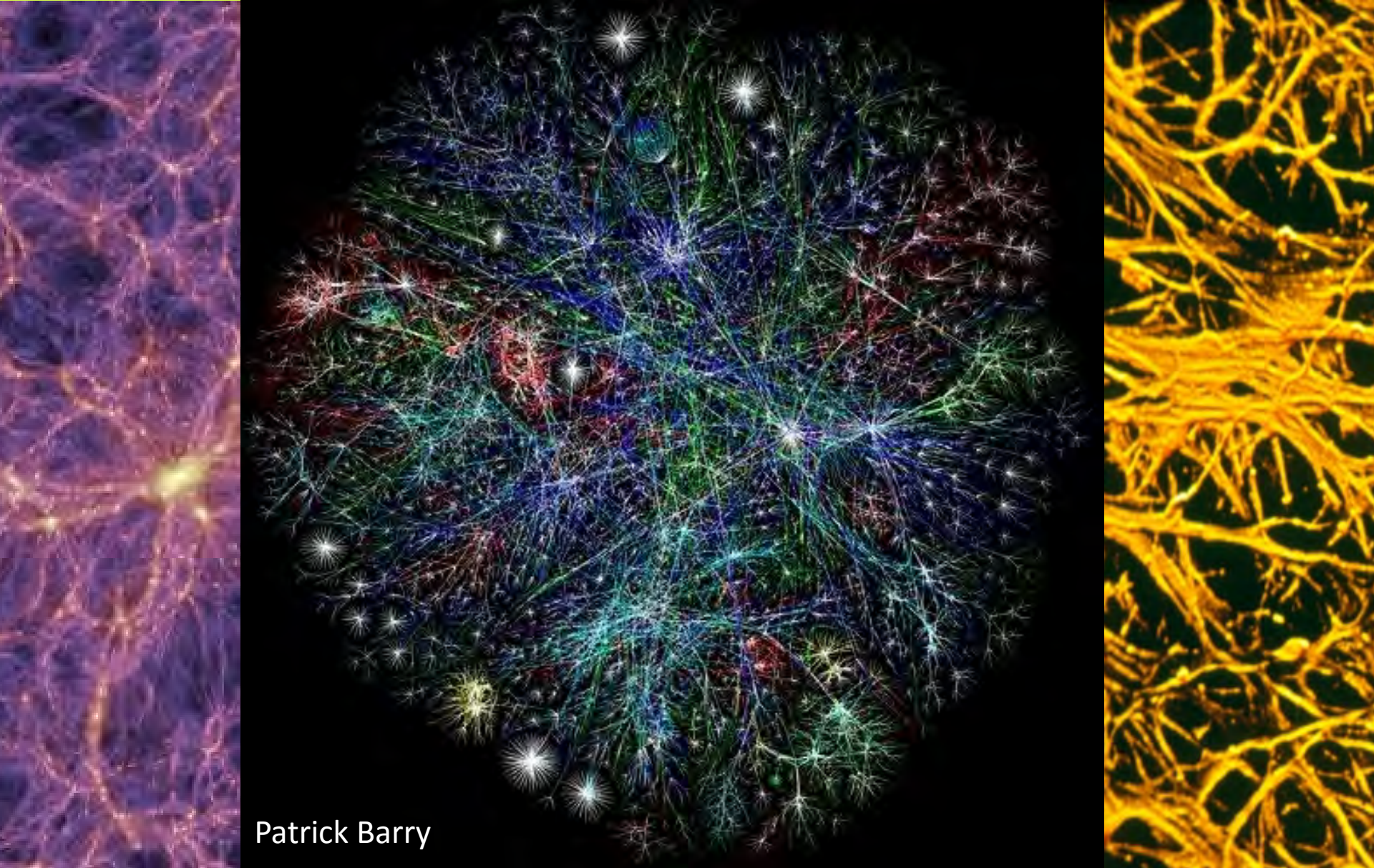
MYCELIUM RUNNING

How Mushrooms Can Help Save the World



PAUL STAMETS author of *Growing Gourmet and Medicinal Mushrooms*

As Above, So Below



Patrick Barry

Mycoremediation

- Mycorestoration
- Mycoforestry
- Agriculture
- Medicine



Steve Axford

Mycoremediation



- Petrochemicals
- Heavy metals
- Radioactive isotopes
- PCB, PCP, PAH
- Dioxins
- Explosives
- Pesticides
- Nerve Gasses
- Explosives
- Microorganisms

Lignin-Modifying Enzymes

- lignin-peroxidase
- manganese peroxidase
- laccases
- H_2O_2 producing enzymes



Mycoremediation Goals

- Mineralisation/transformation to CO_2 , H_2O , N_2 , HCl



Oyster mushrooms break down oils and pesticides, consume harmful bacteria and accumulate heavy metals



<https://www.youtube.com/watch?v=7ZwZfAi9b7Y>

Diesel Contaminated Soil



Battelle Experiment



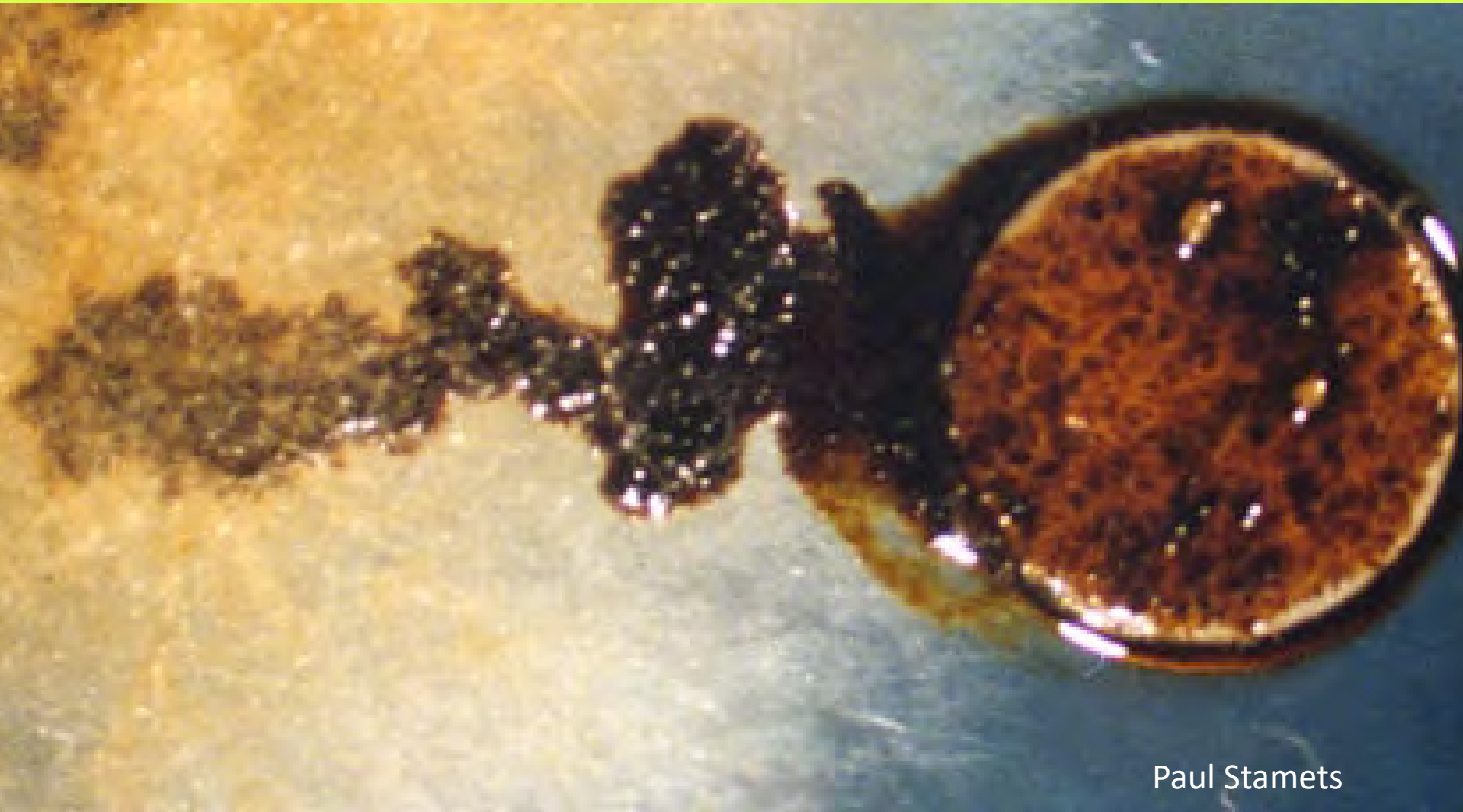
- 97% PAHs converted into mushrooms in 8 weeks

: Susan Thomas

- Diesel contaminated soil (1–2% = 10,000–20,000 ppm = EXXON VALDES SPILL)
+ sawdust spawn + wood chip

<http://www.fungi.com/blog/items/the-petroleum-problem.html#sthash.Sy4geITu.dpuf>

Mycelium absorbing oil



Paul Stamets

The Petroleum Problem - <http://www.fungi.com/blog/items/the-petroleum-problem.html#sthash.Sy4geITu.dpuf>

Experiment for Yourself



Paul Stamets

Pour oil onto oyster mushroom compost - <http://www.fungi.com/blog/items/the-petroleum-problem.html#sthash.Sy4gelTu.dpuf>

Cosco Busan Oil Spill (2007)



Mycobooms™



Paul Stamets

Straw colonised with oyster mushroom encased in hemp-tubes. -
<http://www.fungi.com/blog/items/the-petroleum-problem.html#sthash.Sy4geITu.dpuf>

Mycoboom™ floating in saltwater



<http://www.fungi.com/blog/items/the-petroleum-problem.html#sthash.Sy4geITu.dpuf>

Mycelium of *Trametes versicolor* (white rot) growing on PAH and Dioxin contaminated soil



Aalto University

96% PAHs and 64% dioxin eaten in 3 months

<http://ecowatch.com/2014/05/23/mushrooms-fungi-bioremediation-contaminated-soil/>

House Rotting Fungi



- *Meruliporia incrassata* and *Antrodia radiculosa* degrade pentachlorophenol (PCP) and chromated copper arsenate (CCA)
- *Phanerochaete chrysosporium* (white rot) degrades PCP

Heavy Metals

- Biosorption
- Bioaccumulation



File:Paxillus involutus qtl3.jpg

Heavy Metals



- *Fusarium oxysporum* detoxifies lead and cadmium in aqueous solution forming carbonate crystals (Sanyal et al., 2005)

Radioactive Isotopes

Gomphidius glutinosus

Accumulates caesium 137, 10 000 x above background radiation

Mycofiltration





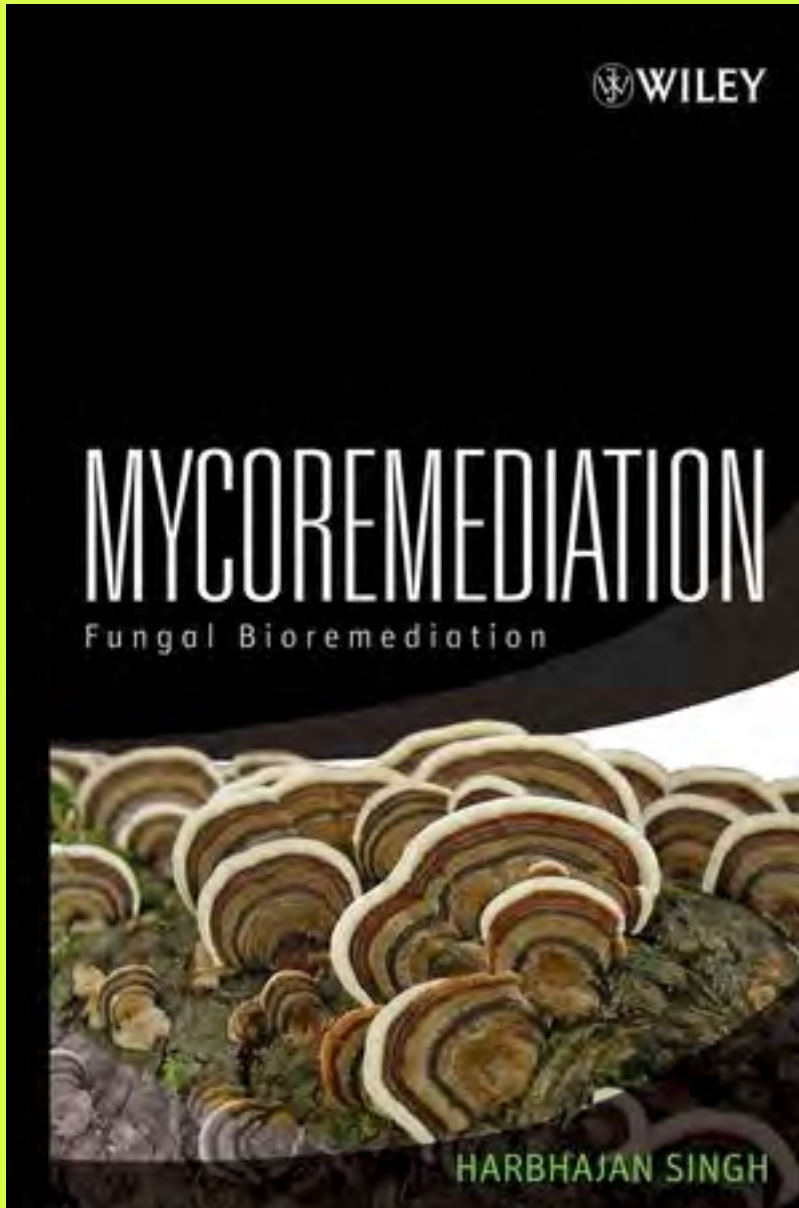
Filter

- Coliforms
- Nitrates
- Endocrine disruptors
- Pharmaceutical residues etc....

Paul's Message

- Fungi can decompose toxic substances, rebuild soils and strengthen our food chains.
- What we lack is the widespread availability of mycologically skilled technicians and educators and a more mycologically informed public.
- We need a paradigm shift, a multi-generational educational infrastructure, bringing fungal solutions to the forefront of viable options to mitigate disasters.
- An unfortunate circumstance we face is that the field of mycology is poorly funded in a time of intense need.

Mycoremediation



- Singh, H. (2006) *Mycoremediation: fungal bioremediation*. Wiley, Hoboken.

http://fmedicine.ajums.ac.ir/_fmedicine/documents/fungal%20bioremediation_20130415_112807.pdf

Mycofun



Mycoyum



Pleurotus australis



<http://www.friendsofqueensparkbushland.org.au/pleurotus-australis/>

No Till Farming



- Preserves soil mycelium
- Mycelium breaks down crop residue
- Holds water in the soil and prevents runoff
- Preserves soil structure
- Reduces fertiliser requirement
- Cuts down pesticide use by 97%
- Reduces energy consumption by half to two thirds
- Prevents 41% CO² release
- Increases soil biodiversity
- Eventual 15% yield increase

The Life Box

- *“In the nineteenth century we stripped more trees from the land than the ice age accomplished in 100,000 years.”*

David George Haskell

- *“If 1 tree out of 100 will survive to the 30-year mark, it will have sequestered one ton of carbon.”* — Paul Stamets



Bee Immunity



Mycopesticides



<http://weeklyworldnews.com/headlines/30607/zombie-ants-cause-zombie-outbreak/>

Ants succumb to *Metarhizium* fungus, disguised as food. – Paul Staments

Medicine



Stuart Isett

Reishi mushrooms produce ganomycin.

Agarikon (*Fomitopsis officinalis*)

- smallpox
- swine
- bird flu
- herpes



Paul Stamets

Anti-Cancer



Paul Stamets

Turkey tail mushrooms: Paul's mother was diagnosed with stage IV breast cancer, which disappeared in 6 months, she is still cancer free.

Magic Mushrooms - Psylocybin



<https://www.youtube.com/watch?v=OqWHeofXP6Q>

Biotechnological Potential



- Grown on waste
- Biodegradable
- Hydrophobic
- Extremely durable
- Fire retardant

Oyster Mushrooms on Coffee Grinds

Biofuels

Gliocladium roseum - Glio



- Glio converts plant matter into non-corrosive hydrocarbons

Maurizio Montalti at Myco Design



Myco Foam



Packaging

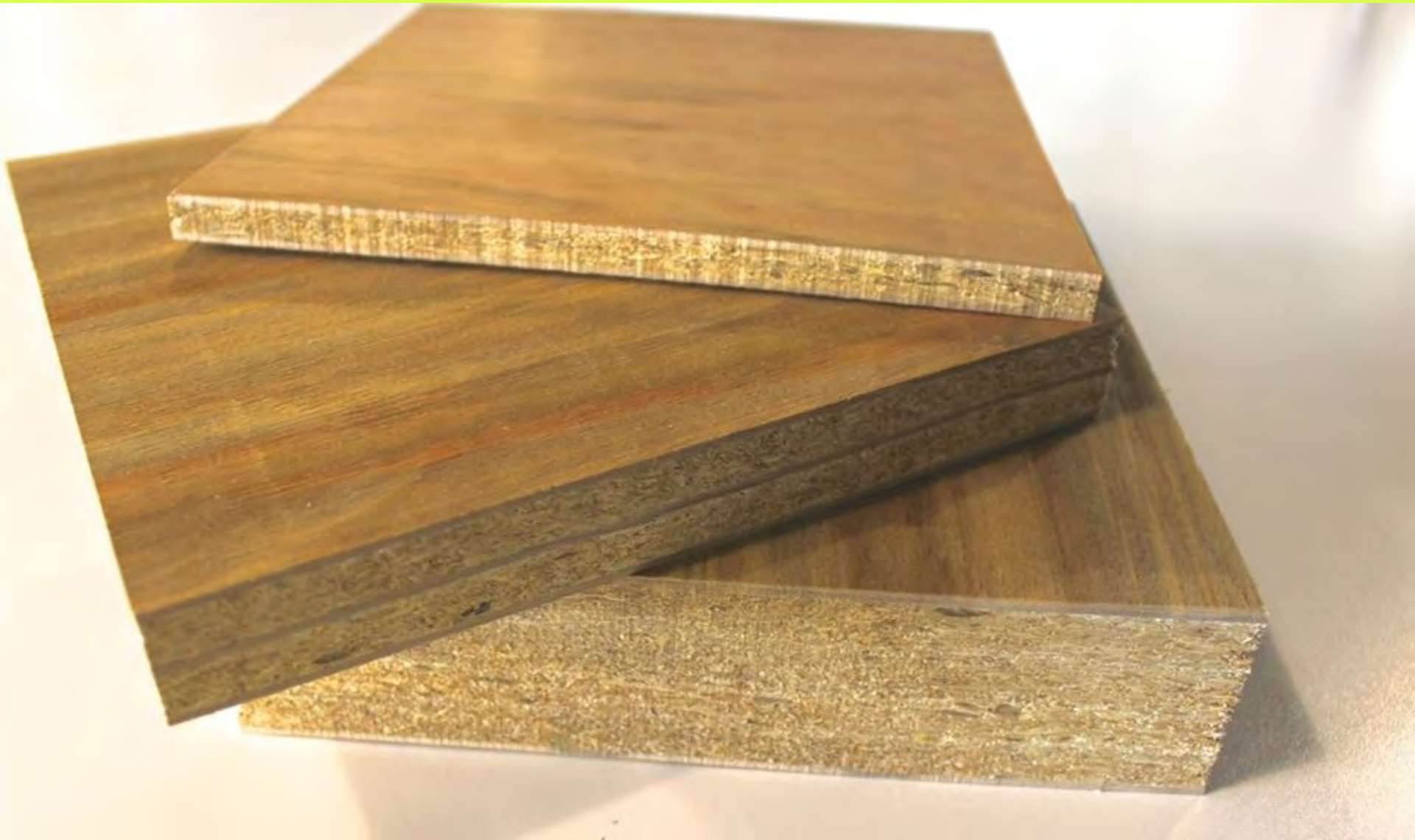


Insulation by Antoni Gandia



<http://www.mediamatic.net/385489/en/mycelium-insulation-panels>

Myco Board



Construction



Phil Ross Designs

Mushroom bricks are one of the toughest materials on the planet. - MycoWorks

Architecture



<http://www.dezeen.com/2014/07/01/tower-of-grown-bio-bricks-by-the-living-opens-at-moma-ps1-gallery/>

Furniture



<http://terreform.blogspot.com.au/2015/06/mycoform-surface-multi-curved-mycelium.html>



<http://www.dezeen.com/2013/10/20/mycelium-chair-by-eric-klarenbeek-is-3d-printed-with-living-fungus/>



Art



Clothing



<http://www.dezeen.com/2016/04/01/aniela-hoitink-neffa-dress-mushroom-mycelium-textile-materials-fashion/>

Shoes



Ecovative Surfboards

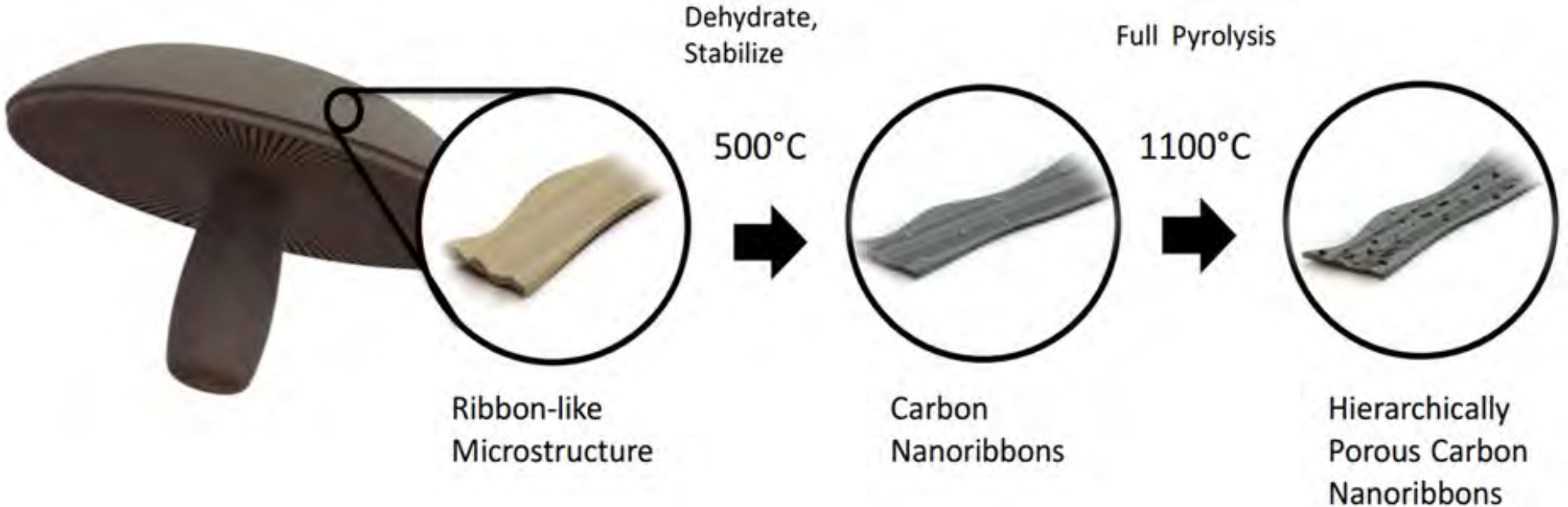


<http://www.surfermag.com>



Low-White

Portobello Batteries



Extremely porous mushroom carbon, contains microscopic pores, a perfect anode for batteries due to exceptionally high surface area to volume ratio.

Food from Plastic



Thank You



Bleeding Tooth Fungus