PRESS RELEASE

When 3D-printed mushrooms make music: Mushroom mycelium as a sustainable high-tech material in speaker construction

Mushroom mycelium is a renewable resource. It has been essential in pharmacy for many years. Yet, mushroom mycelium has even more potential. As a biodegradable material, it can sustainably replace various materials, such as animal leather, packaging materials made from wood, cardboard, or Styrofoam®, and insulation wool. A team of researchers at Fraunhofer IWU is now exploring another application for mushroom mycelium material: for components integrating complex functions in high-quality transmission line speakers, with the aim to enhance their sound even further. The ambitious goal is to process living mycelium in 3D printing and then deliberately influence its growth to achieve sound-reflecting and sound-absorbing properties in one process.

Research findings on the influenceability (or controllability) of mushroom mycelium regarding the specific requirements in speaker construction are highly promising. Characteristics of the material can be adjusted to the respective application during mycelium cultivation by influencing environmental conditions. This way, foam-like structures can be used for sound absorption or damping unwanted vibrations, while solid and smooth properties are suitable for sound reflection. Mycelium is thus a good choice for both insulation material and housing.

So-called transmission line speakers rely on a sound outlet opening in the housing for good bass and reduced resonances (natural vibrations) of the speaker housing. This opening connects to a tube of up to three meters inside the housing. Such a tube must be folded multiple times in the speaker box to fit, resulting in a complex geometry. The high manufacturing costs alone have deterred many manufacturers from this design principle. The IWU team elegantly solves this problem by tool-less printing of functional components and speaker housings. Additionally, this approach reduces the number of adhesive and other joining connections. Overall, 3D manufacturing requires significantly fewer process steps than conventional production methods.

Further cost arguments speak for mushroom mycelium as a material. Recycling organic substrates as the basis of the material is as cost-effective as processing with low energy consumption. Mushroom mycelium occurs in large quantities in the soil. It is also

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extractable from organic materials such as straw, wood residues, sawdust, reed residues, or brewery by-products (spent grains).

Lastly, ecological arguments speak for this material. While machining manufacturing processes such as cutting, milling, or drilling generate a lot of waste, it is the opposite with 3D printing of mushroom mycelium: the printable material comes from organic residues; only what is needed is processed. The material is entirely non-toxic, comparable to edible mushrooms, and fully biodegradable.

The basis for the "MYCOUSTICS" project is previous fundamental research at the institute on the cultivation and processing of mycelium material. In addition, Fraunhofer IWU has comprehensive expertise in technical acoustics and additive manufacturing. The institute masters a wide range of methods for the analysis, simulation, and optimization of the entire chain of sound generation (excitation, transmission, sound radiation). It also leads the Fraunhofer competence field Additive Manufacturing with twenty Fraunhofer institutes nationwide. Another one of the IWU's research activities is functional integrated 3D printing for applications in various industries.

From June 11 to 13, 2024, Fraunhofer IWU in Dresden will host BioM, the most significant international conference on Biomanufacturing and related fields. Sophia Elsner will present research results on the cultivation and printability of mushroom mycelium material at BioM.

MYCOUSTICS is sponsored by the German Federal Ministry of Education and Research within the framework of the DATIpilot funding guideline.

Federal Ministry of Education and Research

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Fig. 1 Material selection and design principles of the housing have a major impact on the sound quality of a speaker (symbolic image)
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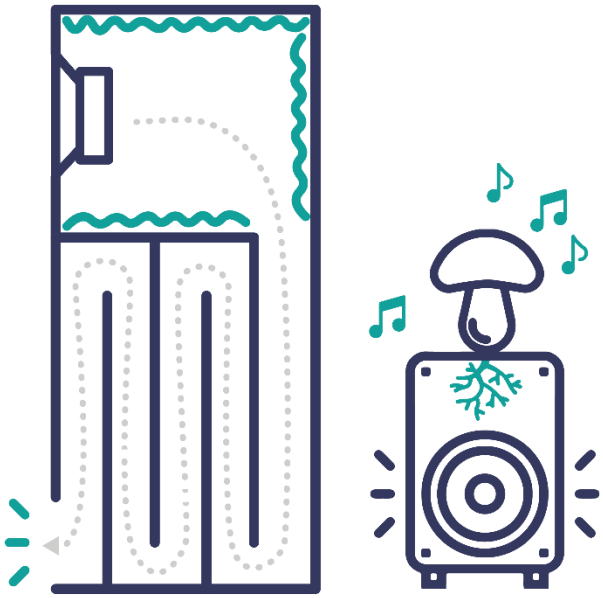

Fig. 2 Schematic representation of the complex geometry of a housing with transmission line
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Abb. 3 Foam-like structures absorb (dampen) sound and reduce unwanted vibrations
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Abb. 4 Solid structures reflect sound and are thus ideal for transmission line structures in the housing
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