BIOMAC–BP Seminar Series

Time: **May 27, 2026 (Wednesday)**
3 PM CET

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Bio:

In ancient times I studied physics and received my PhD in 1995. Followed by a Postdoc position at Stanford University I moved to ETH Zurich 28 years ago. Research in my group (fpe.ethz.ch) focuses on material science, engineering, and processing of food and other soft matter and includes rheology, interfacial characterization, scattering, and extrusion of complex materials such as foam, emulsions, and hydrogels as well as engineered living materials. Once in a while also mud, concrete, microplastic, slime and snot aka the fun stuff receives our attention. Beside that I am very much into photography (fischerphoto.ch).

Material-fungi interactions

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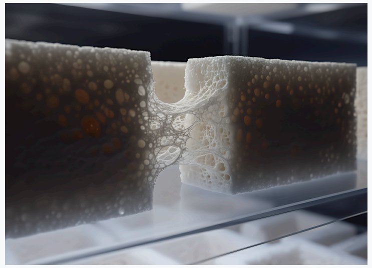

Engineered living materials (ELMs) are an emerging class of biofabricated materials that integrate living organisms, such as filamentous fungi, into structural matrices to achieve hybrid, sustainable biomaterials. To design effective biohybrid materials, it is essential to elucidate the fundamental interactions between the host materials and fungal growth. Understanding how material properties of the host material such as viscoelasticity, hydrophobicity, anisotropy and nutrient concentration influence fungal growth is crucial for optimizing these materials. This contribution explores fungi-host material interactions at the water-air surface, in viscoelastic and lipid host material, in anisotropic scaffolds such as wood hydrogels and in porous host materials as well as host materials of varying nutrient concentrations [1,2]. Additionally, this contribution explores quantitative methods for assessing mycelial growth, including interfacial shear rheology, compression and tensile testing, and fungal mycelium biomass as a proxy for growth analysis. As a result, we can show that anisotropic wood hydrogels acting as growth template and by increasing the concentration of carbon sources in the host material enhances mycelial network density, leading to improved properties such as stiffness in a mycelium biocomposite [3,4]. Additionally, quantifying fungal biomass using fungal-specific ergosterol enables differentiation of biomass accumulation across various growth directions, providing a novel approach to studying three-dimensional mycelial growth in solid-state fermentation [5]. This work provides new insights into designing host material for optimal fungal growth and morphology, along with effective methods for quantification. It demonstrates that fungal growth in templated substrates provides a framework to design biofabricated materials.

References

[1] N. Nussbaum, T. von Wyl, A. Gandia, E. Romanens, P.A. Rühs, P. Fischer: Impact of malt concentration in solid substrate on mycelial growth and network connectivity in Ganoderma species, Sci. Rep. 13 (2023) 21051

[2] C. Wobill, P. Azzari, P. Fischer, P.A. Rühs: Host material viscoelasticity determines wrinkling of fungal films, ACS Biomater. Sci. Eng. 10 (2024) 6241–6249

[3] C. Wobill, Z. Zhang, P. Fischer, P.A. Rühs: Anisotropic growth of filamentous fungi in wood hydrogel composites enhances mechanical properties, ACS Appl. Bio Mater. 8 (2025) 5024

[4] N. Nussbaum, N. Repond, A. Gandia, P.A. Rühs, P. Fischer: Mycelial growth of wood fungus Ganoderma sessile in porous scaffolds, Mater. Today Bio 35 (2025) 102282

[5] N. Nussbaum, L. Balmelli, P.A. Rühs, P. Fischer: Quantifying fungal growth in 3D: an ergosterol-based method to distinguish growth modes, Mater. Adv. 6 (2025) 7261