The Convergence of Living Essence and Engineered Innovation

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Book of Abstracts

Chairpersons

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From traditional to living: transforming architectural coatings with ELMs

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The field of architecture is increasingly focused not only on designing new structures but also on the sustainable maintenance and protection of existing buildings. With the expansion of urban landscapes due to population growth and the increasing need to maintain aging infrastructure, the demand for sustainable and innovative solutions in construction and material science continues to rise. Architectonic surfaces exposed to outdoor conditions undergo biotic and abiotic deterioration processes, necessitating further development of protective coatings. Architectural coatings are designed to protect surfaces against degradation while often providing decorative value. However, conventional surface treatments typically contain mineral oil binders and other environmentally harmful ingredients. Engineered Living Materials (ELMs) offer a groundbreaking alternative by utilizing living building blocks instead of traditional synthetic materials also in the building sector [1]. These materials integrate microorganisms as active components, either as part of a matrix or within a living scaffold. The ARCHI-SKIN project adopts a bioinspired approach to develop novel architectural coatings. A prototype microbial coating, currently under development, utilizes biofilms formed by the ubiquitous yeast-like oligotrophic fungus *Aureobasidium pullulans*. This coating is engineered to form controlled and optimized biofilms that effectively protect substrate surfaces, ensuring extended service life while introducing self-healing and bioremediation functionalities. Our research explores fungal biofilm engineering, including the assessment of the bioreceptivity of building materials, capabilities of biofilm production by various strains, growth assessment by time-lapse microscopy, optimization of fermentation broth, and mathematical modeling of fungal development (Fig.1) [2]. The study also experimentally assesses nutrient compatibility and optimizes nutrient interactions using molecular docking techniques. By developing a living coating system, the ARCHI-SKIN project aims to redefine traditional material concepts, envisioning coatings that adapt, interact, and respond dynamically to environmental changes.

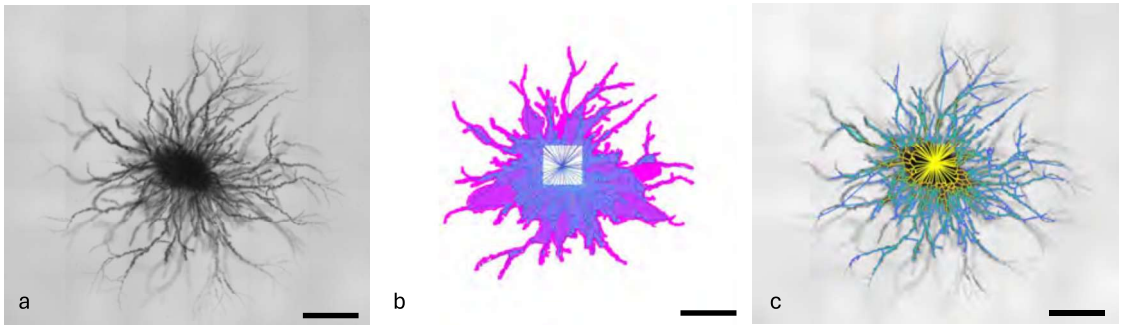

Figure 1. Integration of microscopic observations and mathematical modeling: a) bright-field microscopy image of *Aureobasidium pullulans* on Synthetic Nutrient Deficient Agar (SNA) with 0,01% chitosan dissolved in 1M glycolic acid grown for 72 hours at 25°C, b) intermediate step, c) corresponding image overlayed with the encoded graph. Scale bar: 1 mm.

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References

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