$2 Million award from National Science Foundation will support interdisciplinary team to develop 3D-printed microorganisms for sustainable construction materials

An interdisciplinary research team led by University of Washington Chemistry Professor Alshakim Nelson received $2 million in funding from the National Science Foundation's Emerging Frontiers in Research and Innovation (EFRI) program. The funding will be used to combine engineered microorganisms with 3D printing to create materials for sustainable built environments. This grant will provide funding to researchers at UW, the University of Texas at Austin, and University of California Davis over four years.

"Engineered living systems for construction and other building materials have the potential to afford a level of durability and sustainability that cannot be achieved with our traditional materials," said Nelson. Professor Hal Alper, a metabolic engineer at UT Austin and a long-time collaborator of Nelson, adds "3D printing engineered living materials will allow scientists, architects, engineers, and other users to fabricate materials with unique characteristics for any custom application and design." In addition to Nelson and Alper, the team also includes Professor Ayokunle Olanrewaju, a microfluidics expert at the UW in Mechanical and Bioengineering, Professor Gundula Proksch, an expert in sustainable urban infrastructures in the UW Department of Architecture, and Professor Shota Atsumi who is a leader in engineering cyanobacteria at UC Davis.

The team's primary goal is to address fundamental challenges associated with integrating living microbial organisms in materials designed for the outdoor built environment. The team will develop 3D printed engineered living systems (ELiS) that can self-strengthen/repair under low-hydration conditions and hydroponic ELiS with bio-sustained function and biocontainment. The project aims to meet the future global demand for advanced biomanufacturing technologies that reduce carbon footprint and increase chemical recycling. Distributed biomanufacturing, where materials are produced locally through 3D printing, instead of at central manufacturing facilities could reduce transport costs and the amount of petroleum-based products used in the process. The team will also investigate fully biodegradable EliS that enables biochemical recycling of the materials.

While humans have had a long-standing relationship with microorganisms for food and beverage production (for example, yeast is used to make bread and wine), the idea of using microorganisms for making construction materials has only emerged over the last few years. In anticipation of the future importance of this field, the team will establish programs to educate the public and develop the future workforce. Next year, Proksch will lead an interdisciplinary research seminar and studio to offer students the opportunity to 3D-print engineered microorganisms. "We want to attract students not only from traditional STEM fields, but also from design, architecture, and allied built environment disciplines" says Proksch. "The students will have an opportunity to explore this new paradigm in a collaborative space, to explore the merging of biology and the built environment to solve sustainability issues."

For more information, please see the project website https://elis.be.uw.edu/.

This project is funded by National Science Foundation (NSF), award #2223537, EFRI ELiS: Emerging Frontiers in Research and Innovation (EFRI-2022/23) Engineered Living Systems (ELiS).