Carl-Zeiss-Stiftung supports research project on wood-based materials at the University of Freiburg

The Carl Zeiss Foundation is funding the "DELIVER - Data-driven Engineering of Sustainable Living Materials" project at the University of Freiburg in its "CZS Wildcard" program. In the project, scientists from the Freiburg Clusters of Excellence CIBSS and livMatS will develop sustainable wood-based materials whose properties can be precisely controlled.

The materials are based on microorganisms that release proteins and can use them to combine wood waste into biocomposites. The researchers will direct this process using optogenetic methods to obtain materials with controllable properties that will be characterized using various methods. The project will receive nearly 750,000 euros over two years. It is coordinated by Prof. Dr. Wilfried Weber, a researcher in synthetic biology at the Cluster of Excellence CIBSS - Centre for Integrative Biological Signalling Studies at the University of Freiburg. "We are pleased that we were able to impress with our DELIVER project," says Weber. "This gives us an outstanding opportunity to pursue novel avenues towards sustainable materials."

Approach based on the intersection between materials science, synthetic biology and machine learning.

DELIVER is inspired by the ability of living organisms to produce materials with specific properties adapted to external conditions. The scientists will make use of this ability: The goal of the project is to design wood-based multi-material systems whose mechanical properties and appearance can be specifically targeted. "We are treading a completely new path with our approach, as it starts at the intersection between materials science, synthetic biology and machine learning," says Prof. Dr. Thomas Speck, a biologist in the Cluster of Excellence Living, Adaptive and Energy-autonomous Materials Systems (*liv*MatS). Together with Dr. Tom Masselter, he is responsible for characterizing the physical and mechanical properties of the multimaterial systems in the DELIVER research team.

Controllable material properties through optogenetics

The researchers will use optogenetic methods to modulate the material properties. These methods can be used to influence the information processing of cells, which controls how external stimuli are interpreted and which genetic programs are activated in the cells. "We use light of specific wavelengths with which we locally irradiate the microorganisms as a stimulus," Weber explains. "In this way, we activate genetic switches that direct the production of specific proteins." This makes it possible to direct which proteins are released by the bacteria and yeasts, which are used to bind wood chips or other, agricultural waste. The resulting biocomposites are then baked to kill the bacteria.

Database with custom fit materials

The various parameters that researchers can change will make it possible to achieve a wide range of material properties in the future. The project will therefore create a database that records the relationship between genetic program and material property. Various machine learning methods will be used to predict new material properties and optimize them, a project part led in the research team by Dr. Clemens Kreutz. Robots will automatically synthesize the different material variants and perform mechanical tests. Based on the database, it will be possible in the future to specifically generate and optimize materials with desired properties, for example for furniture construction.

About the Cluster of Excellence CIBSS

The Cluster of Excellence CIBSS - Centre for Integrative Biological Signalling Studies aims to gain a comprehensive understanding of biological signaling processes across scales - from the interactions of single molecules and cells to the processes in organs and whole organisms. With the knowledge gained, signals can be controlled in a targeted manner, and this in turn enables researchers not only to gain insights in research, but also to innovate in medicine and plant sciences.

About the Cluster of Excellence livMatS

The vision of the Cluster of Excellence Living, Adaptive and Energy-autonomous Materials Systems (*liv*MatS) is to combine the best of two worlds: nature and technology. *liv*MatS is developing life-like material systems inspired by nature. These systems will autonomously adapt to environmental conditions, harvest clean energy from their surroundings, and be insensitive to or self-compensating toward damage.

About the Carl-Zeiss-Stiftung

The Carl-Zeiss-Stiftung has set itself the goal of creating scope for scientific breakthroughs. As a partner of excellent science, it supports both basic research and application-oriented research and teaching in the STEM disciplines (science, technology, engineering and mathematics). Founded in 1889 by the physicist and mathematician Ernst Abbe, the Carl-Zeiss-Stiftung is one of the oldest and largest private science-funding foundations in Germany. It is the sole owner of Carl Zeiss AG and SCHOTT AG. Its projects are financed from the dividend distributions of the two foundation companies.

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Further information

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