A combination with high-tech potential: peptides and inorganic materials

At the University of Stuttgart, molecular bionics researchers are working on opening up strategies for the development of new materials. Researchers at the Institute of Technical Biochemistry are investigating compound materials consisting of peptides and inorganic components. A project focusing on the development of layer structures is receiving funding from the Baden-Württemberg government.

Biotechnology has led to many innovative concepts and can now add another to its long list of successes. Researchers from the Institute of Technical Biochemistry (ITB) at the University of Stuttgart are focusing on the development of new materials by combining organic and inorganic components into compounds with sought-after properties for a broad range of different applications. "This is completely new. Biotechnology has produced good results for many things, including pharmaceutical and materials production; now we are planning to combine inorganic chemistry with biotechnology," said ITB director Prof. Dr. Bernhard Hauer.

This idea has led to many projects and the reviewers of the "Molecular Bionics" programme of the Baden-Württemberg government have just selected one of these projects for one-year funding. In cooperation with a team of researchers led by Prof. Dr. Joachim Bill from the Institute of Materials Sciences at the University of Stuttgart, the ITB researchers are developing special layer materials. "Our goal is to produce small peptides from seven to 30 amino acids, which then bind to specific inorganic materials such as titanium or zinc oxide. The ultimate goal is to produce a material with alternating layers or inorganic and organic compounds. The peptides thus form a connecting as well as a separating layer," explains Hauer.

Another goal: inexpensive production of materials

Prof. Dr. Hauer has been working for many years on enzymatic processes for the production of chemicals, both in industry as well as in academic research institutions.

Such layer constructs are interesting, amongst other things, for the construction of electronic components; they can also be applied in the field of sensor systems. “Such layers can react to current and heat, guide current or emit light. This opens up new options for control and measurement functions,” said Hauer citing car dashboards and modern display systems in general as examples.

At present, the major challenge is the development of a method that enables the production of selectively binding peptides. The scientists intend to use a novel type of phage technology. In principle, bacteriophages can be modulated to produce outer membrane proteins that contain the sought-after peptides. “We want to identify the peptides by allowing them to bind to certain surfaces. A counter-selection then helps us to ensure that the peptides do not bind to other materials,” said

The inorganic structure of mussel shells serves as a model for molecular bionics.
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Hauer who is also very interested in producing the peptides relatively cost-efficiently. His goal is to develop materials with unique characteristics at low cost, because he believes that this is the only way that they will be used for a broad range of applications.

Investigating protein properties with computer simulations

The researchers also plan to expand the concept of combining inorganic and organic materials to other areas and envisage such materials being used, for example, as innovative ceramics in implants or construction composites in the construction sector, with defined properties in terms of hardness, breaking and tensile strength. The ITB team is inspired by molecules in nature, it carries out basic research across the entire field of biology and cooperates with experts from the respective disciplines. “We would like to understand how inorganic structures function, including for example those involved in the development of mussel shells or those that constitute the silicate scaffolds of sponges,” said Hauer.

The researchers from Stuttgart do more than just produce peptides. They also use these peptides to

carry out complex and time-consuming computer simulations. “In this, we greatly benefit from the support from our partners in the SimTech excellence cluster at the University of Stuttgart. We use the simulations to find answers to questions relating to the peptides’ recognition elements and their selectivity,” said Hauer. Although the researchers’ work still focuses predominantly on basic research, Hauer is already in contact with a range of industrial companies, from companies in the chemical industry to companies in the automotive sector, all of whom appear to be extremely interested in the new developments.

Article

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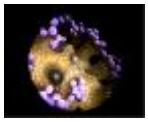

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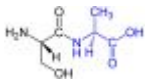

Peptides – diverse molecules of life