Fraunhofer
IFAM

FRAUNHOFER-INSTITUT FÜR FERTIGUNGSTECHNIK UND ANGEWANDTE MATERIALFORSCHUNG IFAM


1

PROTEIN-BASED MATERIALS

Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM – Adhesive Bonding Technology and Surfaces –
Wiener Strasse 12
28359 Bremen | Germany

Institute Director
Prof. Dr. Bernd Mayer

Contact

Adhesives and Polymer Chemistry
Dr. Ingo Grunwald
Phone +49 421 2246-630
ingo.grunwald@ifam.fraunhofer.de

Dr. Klaus Rischka
Phone +49 421 2246-482
klaus.rischka@ifam.fraunhofer.de

www.ifam.fraunhofer.de

Inspired by nature

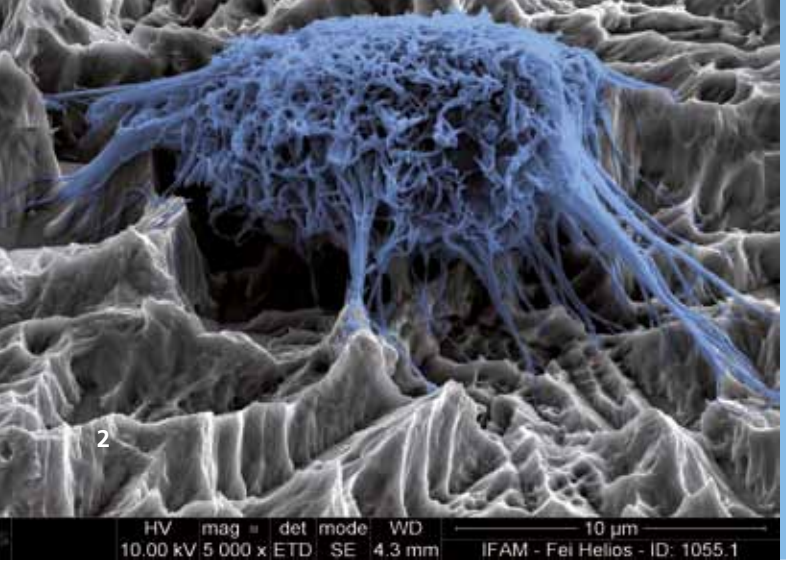
In nature, protein-based adhesion systems are known exhibiting combinations of properties which hitherto could not be reproduced as synthetic adhesives. For instance, marine organisms like mussels or barnacles have evolved ways of adhering to different surfaces in a salt water environment. Such adhesive compounds are not only robust, but are also capable of withstanding the strongest underwater currents and eddies. Of further research interest are marine life forms which, when required, are capable of releasing adhesive contact within seconds.

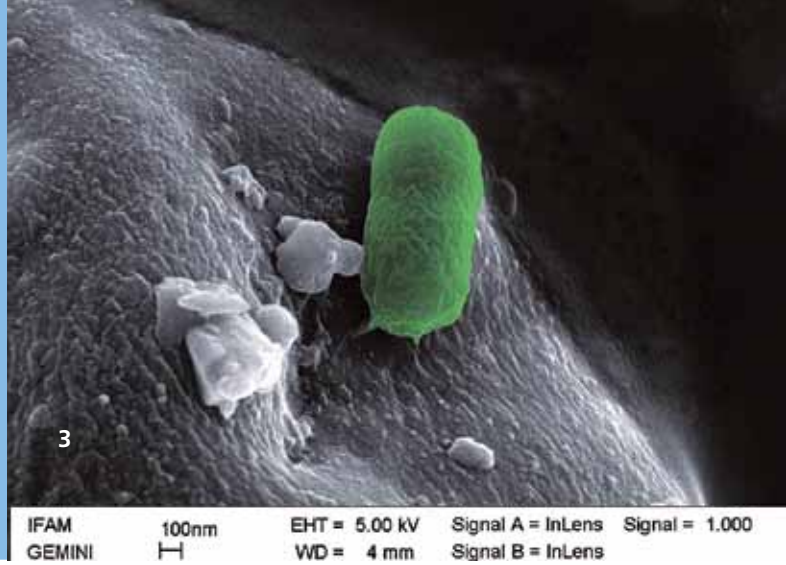
Protein-based adhesives

The main components of natural adhesives have been identified as belonging to the category of proteins. These macromolecules consist of amino acids and perform different functions, depending on their composition. Moreover, proteins not only form the basis of an organism's targeted adhesion to surfaces, but also the cohesion of living cells amongst each other. Without these capabilities it would not be possible for multicellular forms of life to exist. On the basis of these adhesion mechanisms, Fraunhofer IFAM is now working on the design and synthesis of protein-based adhesives.

Investigations concentrate on gaining a better understanding in the areas of protein-protein- and protein-surface-interaction, whilst taking into account the resulting molecular adhesion mechanisms. Research findings will be applied to the development of peptide-polymer hybrids on the basis of the Mefp-peptides found in blue mussels. The aim is to transfer the working mechanisms onto fully synthetic materials.

Possible fields of application arise not only in the area of "adhesion under water", but especially in medicine: the closing of wounds, for instance.





Biofunctionalized surfaces

In addition, investigations will encompass the implications of surface interaction connected with living matter; for example, the creation of targeted cellular interaction with artificial surface materials, biofunctionalized nanoparticles as actuators, and protein chips in diagnostics. They also allow technical surfaces having special functions, such as anti-icing and anti-fouling properties, to be realized.

Portfolio of the Fraunhofer IFAM

A resulting service offer is the solid-phase synthesis of peptides as well as the characterization of proteins and peptides by means of MALDI-TOF mass spectrometry. Furthermore, determination tests of the secondary structure and interaction of proteins and peptides by means of FT-IR-spectroscopy. In addition, studies are being undertaken on the effectiveness and biocompatibility of coatings on medical products and other technical surfaces (e. g. coatings for ships).

1 *Blue mussels attach themselves to surfaces via their byssus filaments which function as a protein adhesive. The adhesive can be seen as the white points of attachment to the glass surface.*

2 *Human cell on a dental implant.*

3 *Cell adhesion – SEM micrograph of a bacterial cell (Escherichia coli) on nitrocellulose.*