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07.02.2012, OHB System AG, Bremen

A photograph of an astronaut in a white spacesuit working on the exterior of the International Space Station. The astronaut is positioned in the center-right, reaching towards a large, complex structure of the station. The background shows the Earth's blue and white clouds. The image is framed by a blue curved border at the top.

SPACE SYSTEMS

Space Biomimetics, Biomining, and Applications

United Nations Committee on the Peaceful Uses of Outer Space

Scientific and Technical Subcommittee: 2012

Forty-ninth session

Manned Peaceful Exploration of Outer Space

Possible only by using SUSTAINABLE Technology

Bionics (also known as biomimicry, biomimetics, bio-inspiration, biognosis, and close to bionical creativity engineering) is the application of biological methods and systems found in nature to the study and design of engineering systems and modern technology [cited from Wikipedia]

Examples and Application Potentials

Examples:

- **Biomimetic Adhesives**
- **Biomimetic Surfaces**
 - **AntiFreeze /-Microbial**
 - **Biomining**
 - **etc.**

Evolution of Life in changing environmental conditions drives to organisms most suitable adapted to these conditions with highest efficiency.

„Biomimetics“

BIOLOGY

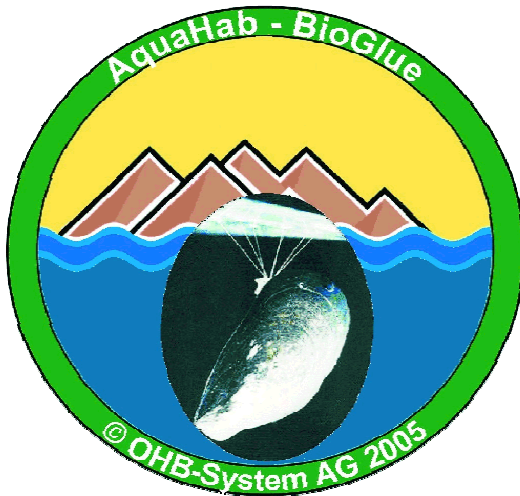


TECHNOLOGY

... deals with the analysis of being close to the application of biological principles in nature....
.....and their innovative transformation into technical application



- optimize existing technical solutions
- find technical solutions for unsolved problems



BioGlue – A feasibility study

Glue2Space - an ESA “Innovation Triangle Initiative” (ITI) project

Natural adhesives and gluing technics as applied environmental strategy for the application in “Closed Environmental Life Support Systems” – CELSS



■ **Cooperation:**

- **ESA**
- **Bionik Systeme**
- **IFAM Bremen**



Earth and Space application:

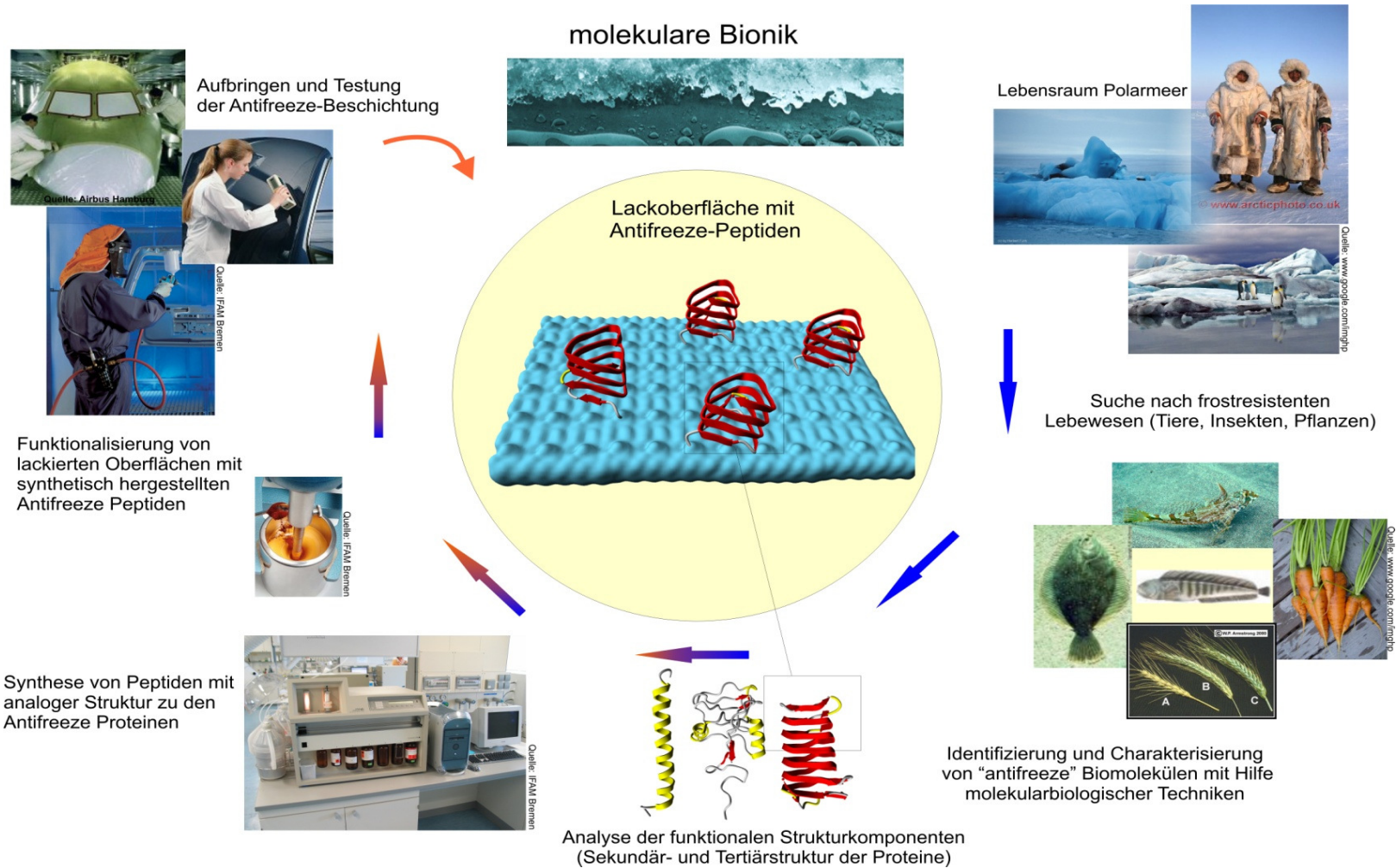
- **Weight saving**
- **High stability**
- **Low attack to the surface**
 - Under water glueable
- **Bacteria resistant**
 - Avoids the attack of organism
- **Non-toxic**
 - Biocompatible (Crew & other life forms)

Project: Glue2Space (ESA “Innovation Triangle Initiative”):

- the application scenario was more detailed defined
- a new biomimetic adhesive based on the adhesive of the blue mussel *Mytilus edulis* was:
 - a) **realised** (Cooperation partner Fraunhofer-Institute, IFAM, Bremen)
 - b) **tested** regarding aerospace relevant materials (Polycarbonat, AlMg_3 , AlZn_6MgCu) and characterised concerning:
 - 1) Quality of bonding strength
 - 2) Resistance against humidity
 - 3) Resistance against fungi and microorganism
 - 4) Optimal storage conditions
 - 5) Environmental compatibility (AquaHab-Testsystem)
 - 6) Maintaining of bond strength in an aquatic medium

Examples and Application Potentials — AntiFreeze

(Partners: Bergolin GmbH, Liebherr Hausgeräte GmbH, IFAM, OHB System AG)



Examples and Application Potentials — AntiMicrobial

(Partners: EVONIK GmbH, HS Bremen, IFAM, OHB System AG)

The problem



**Fungi and bacteria
(Space Station MIR)**

Solution

- Micro-/Nano-coating (Micro-silver etc.)
- SAM-Polymers
- Modified peptides

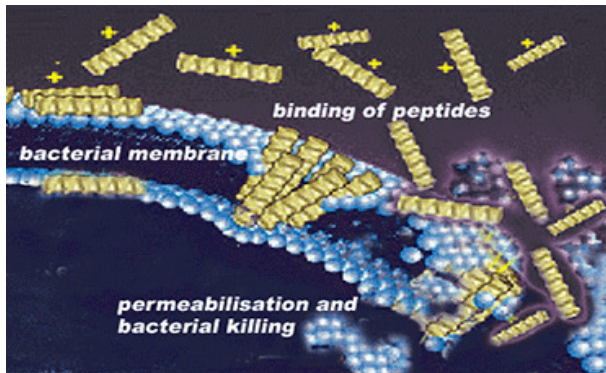
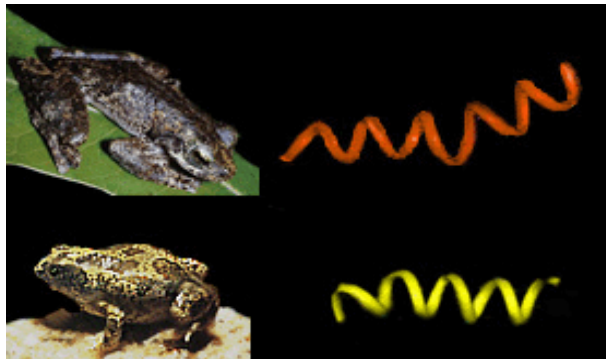
Application:

**Integrated Surface Coatings in
manned space crafts and –
stations as well as closed
systems/ Life Support Systems
on Earth**

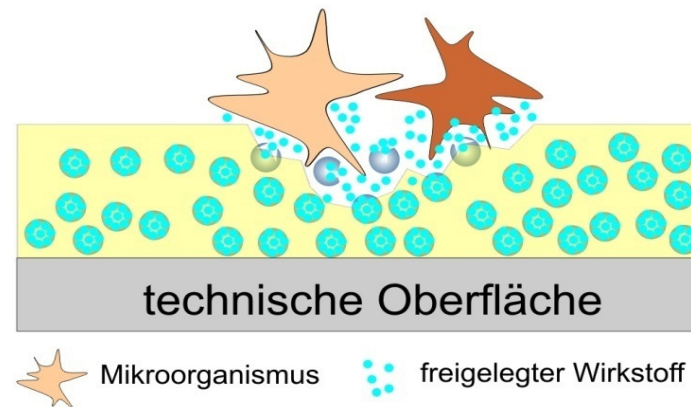
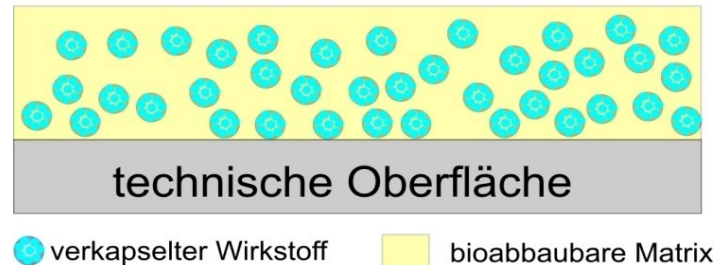
Medical technology

Security

Examples and Application Potentials — AntiMicrobial



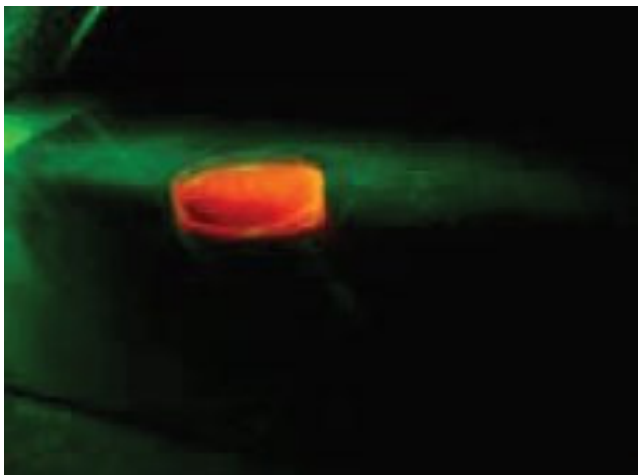
Functional surface with antimicrobial peptides (for example taken from: frogs)



„Antifouling on demand“ – First release of active agents, starting after contamination with microorganism (© IFAM)

Examples and Application Potentials — Biomining

Detection of Explosives by Organisms



Height (km)		0,1 - 3	bis 10	LEO/GEO
System	Handheld-Systems	Civile System	CONDOR	Satellite
				
Scope:		Detection of Explosives		
Scenario:	TBD	TBD	TBD	TBD

ESA – ITT 10.1AA.02 “Space Assets for Demining Assistance (Previous Title: Landmine Detection Service“ (activity started): Support by EO, Sat-Communication and Sat-Navigation

- Establishing of Social and Economical „Impact-Maps“, Priorisation / Mapping
- Identification of „Low Risk Areas“
- Charakterisation of Environmental Characteristics in the Dedicated Areas

Summary:

Biomimetic Developments for Space Application
Increase
Sustainability
in Design and Engineering

Biomining is an Extraordinary Example for Peaceful Use
of Biological Engineering and "Directed Evolution" not
Using GMOs

Thank You for Your Attention !

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