

## **Tribology for life**

### ***New ways of friction, adhesion, lubrication and wear management inspired by nature***

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#### **What is Tribology?**

Tribology deals with interacting surfaces in relative motion, their friction, adhesion, lubrication and wear. Examples for man-made tribosystems are Formula 1 engines, cutting tools with superhard coatings and tiny nanomachines that are lubricated with monomolecular lubricant layers.

#### **Tribology - Inspired by living nature**

Tribologists are continuously pushing the boundaries regarding efficiency of their tribosystems and have recently started to look at living nature for inspiration. Why? Well, there are many great, optimized natural tribosystems!

..... *within the human body*

Have you ever thought about the millions of cycles your hip joint goes through in the time span of your life? The human hip with its cartilage and synovial fluid teaches us how to optimize lubrication properties for long-time applications (decades!).

..... *from the sea*

Another example is chitons, who are marine molluscs: they have Iron stored close to their magnetite-coated teeth, which can easily be renewed as they wear. The jaws of certain marine worms contain Copper and Zinc that reinforce protein fibres in their jaws, and so they can process really hard food. And the dactyl club of the pistol shrimp, which he uses in the wild to hunt, can break the glass of your aquarium at home.

#### **Biomaterials: Nature takes a structure-based approach .....**

Our current engineering is mainly materials based, not structure based like in nature. Biomaterials are different: Material-wise, they are cheaply produced, and a set of base materials is used in slight variations again and again, but knowledge-wise, they are highly elaborate (cf. ordered nanostructures for directional wettability and self-cleaning in many surfaces of organisms, such as lotus leaves, snake skin and butterfly wings). Natural materials are optimized reinforced composites that can for example inspire new strong and tough yet lightweight car frames.

#### **Biomimetics. Living nature's applications in science and engineering**

Biomimetics is an interdisciplinary field that deals with identification of the deep principles of materials, structures and processes in living nature and subsequent application in fields such as science and engineering.

*Biomimetic: systems-based approach towards engineering has tremendous potential*

In living nature as in tribology, systems aspects rather than isolated properties are of high importance. One maximised component does not help the tribosystem/natural system, but can even harm it (example: a too strong screw can break the frame); it is the whole that has to be considered. Interdisciplinary biomimetic approaches can help engineers to even better push the boundaries of our technologies, and include aspects of sustainability and efficiency that will be of paramount importance for the future of our mobility.

### **Asia – The next frontier of Biomimetics?**

Especially in Asia, which has always been open to novel, even disruptive ways of doing things, such a bioinspired approach to tribology might yield the necessary impetus for creative development of new products that help to reach our goals in a way that is conducive to life.