**VO Biomaterials**

SS 2007, 2 units
Course language is English.

**Lecturer:**

Doz. Dr. Helga Lichtenegger, E 308 Institut für Werkstoffkunde und Materialprüfung,
Tel: +43-1-58801-30866, E-mail: helga.lichtenegger@tuwien.ac.at

**Course Aims:**

*To understand the design principles and mechanical optimization strategies of selected biological materials.*

The production of materials with specifically designed properties or "smart" functionalities such as self-repair may still be a challenge for us today, but there are a variety of examples already available in Nature. In spite of strictly limited resources and limitations imposed by environmental conditions, sophisticated biological materials have evolved over time. They are specially adapted to fulfill certain tasks and are mechanically optimized. Even today, some of them still surpass their synthetic counterparts in many respects.
In this course, selected biomaterials will be presented and their structure, mechanical properties and design strategies explained. A brief overview possibilities to use design principles from Nature for novel types of synthetic materials shall be given as well.

**Course Subjects:**

- Basic elements of biomaterials (proteins, sugars, biominerals)
- How biomaterials are formed: concept of self assembly and growth
- Mechanical properties of biological materials
- "Smart" materials properties: adaptive growth, self-healing
- Biomimetics: what can engineers learn from biological materials?
- …and a variety of selected materials as examples:
    - Fibers:
      Collagen: why tendons stiffen upon straining; why is cornea transparent whereas tendons are not.
      Spider web: why flies don't get expelled from the web upon hitting it (in contrast to a trampoline).
    - Cellular materials in plants:
      Why wood is the ideal material to build the highest, most lightweight column (cellular structure, nanocomposite architecture of the cell wall).
      How plants adapt to changing mechanical stress (adaptive growth).
    - Bio-ceramics:
      Bones and teeth: a nanocomposite of mineral and collagen
      Mother of pearl: 3 times the strength and 3000 times the toughness as compared to pure calcite by adding just 1% of protein to the mineral.

**Examination modalities:**
Oral exam

**Literature:**

There are lecture notes available in class.

*Further reading:*

"Structural Biological Materials - Design and Structure-Property Relationships", ed. M. Elices, Pergamon (2000).

"Structural Biomaterials", J. Vincent, Macmillan (1982), Princeton University Press (1990, revised edition).

"Biomineralization – Principles and concepts in bioinorganic materials chemistry", S. Mann, Oxford University Press (2001).

"Wood – The internal optimisation of trees", C. Matthek & H. Kubler, ed. T. E. Timell, Springer, (1995).

"Cats' paws and catapults - mechanical worlds of nature and people", S. Vogl, W.W. Norton & Co, New York (2000)