s7'.m2.o1 **Hierarchical structure of bone and wood studied by scanning x-ray scattering**. P. Fratzl[1], P. Roschger[2], I. Zizak[1], H. Lichtenegger[1], O. Paris[1], K. Klaushofer[2] [1]*Erich Schmid Institute of Materials Science, Austrian Academy of Sciences, and Metal Physics Institute, University of Leoben, Jahnstr. 12, A-8700 Leoben, Austria,* [2]*Ludwig Boltzmann Institute of Osteology, Hanusch Hospital, Vienna, Austria*.
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Bone and wood are hierarchically structured biological materials. A human vertebra, for instance, is a foam-like material with a hard outer shell. At a lower level, bone is often lamellar, consisting of stacked layers with parallel collagen fibrils reinforced by calcium-phosphate particles. This defines very different length scales, namely the thickness of the walls in the foam-like structure (several hundred micrometers) and the size of the reinforcing particles (several nanometers). Somewhat similarly, wood has a honeycomb structure with parallel tubes (diameter = several ten micrometers) made of a composite of cellulose fibers (diameter = several nanometers) and lignin. Since the mechanical properties of this type of material depend on the structure at all hierarchical levels, it is important to use methods capable of giving information on several length scales simultaneously.

Synchrotron x-ray scattering with a microbeam is a powerful tool for investigating simultaneously the nanometer- and the micrometer-range structure. Indeed, x-ray diffraction (XRD) or small-angle x-ray scattering (SAXS) probe the nanometer range, while the larger length scales are covered by scanning the specimen across a narrow x-ray beam (typically a few micrometers in diameter). We show recent examples for the characterization of bone [1,2] and wood [3,4]. Moreover, the micrometer-range image of the specimen can be used to combine x-ray diffraction with other techniques, like scanning-electron microscopy [1] or infrared spectroscopy [2]. A completely new type of information is obtained by correlating these different data (e.g. on structure and on chemistry) on a local level within a highly heterogeneous material.

The potential applications of this new technology are not limited to biological systems. Scanning-SAXS and scanning-XRD can also be advantageous for studying artificial materials with hierarchical structure, such as carbon fiber reinforced carbon, for instance.

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s7'.m2.o2 **X-ray diffraction: an excellent tool in studying the skin structure.** J.A. Bouwstra, G.S. Gooris, M. Ponec*. *Leiden/Amsterdam Center for Drug Research. Einsteinweg 55, 2300 RA, Leiden, *Department of Dermatology, Leiden University Medical Center, Leiden, The Netherlands.*
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The main function of the skin is the protection of the body against undesired influences from the environment caused by exogenous substances. The skin barrier is located in the upper layer of the skin, the stratum corneum (SC) that is composed of dead cells surrounded by hydrophobic crystalline lipid lamellae. Since SC lipids play a dominant role in proper functioning of the skin barrier, a detailed knowledge about the SC lipid organisation is of great importance. In the intercellular regions the major lipid classes are ceramides (CER), cholesterol (CHOL) and free fatty acids (FFA). Several ceramides are present in SC, indicated by CER 1,2...6.

In SC the lipids are organized in two lamellar phases with repeat distances of 6 and 13 nm, of which the 13 nm phase is very characteristic for SC lipid phase behaviour. The lateral packing is mainly orthorhombic.

The individual role lipid classes play in SC lipid phase behaviour has been examined with isolated porcine CER. These studies revealed that CHOL:CER mixtures mimic phase behaviour in SC. Addition of fatty acids induced a phase transition from a hexagonal to an orthorhombic one.

Next to CHOL, FFA and CER, cholesterol sulfate is also present in SC. Addition of cholesterol sulfate to CHOL:CER:FFA mixtures promoted the formation of the 13 nm phase, induced the formation of a liquid phase and increased the stability of the lamellar phases. Based on the results of the x-ray diffraction studies, recently a molecular model has been proposed for the 13 nm phase, that explains the seemingly contrast between the crystalline lamellae and the demand for being elastic in order to follow the sharp edges of the cell boundaries in the SC.