

## **Cellular Materials**

Structural examination techniques, main material groups and properties

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In nature materials that hold the body of the plants and of animals often have cellular structure. In these structures the solid material builds up an interconnected network of struts and walls. The voids which are bordered by them thus create cells. Michail F. Ashby put the ars poetica of research and development of cellular materials into the following phrase:

“When modern man builds large load-bearing structures,  
he uses dense solids, steel, concrete, glass.  
When nature builds large load-bearing structures,  
she generally uses cellular materials: wood, bone, coral.  
There must be a good reason for it.”

Light and stiff materials are generally members of the group. Artificial materials also can be used to form such structures; the shape and size of the cells can be tailored to achieve given properties. By the wide variety of the architecture one combine different favourable material properties, thus creating multifunctional materials, for example heat resistant and energy absorbing.

How the materials of the modern man can be formed into cellular structure? One of the most common processes is foaming achieved by dispersing gas into liquid. Only the materials produced by foaming are called foam, for other foam-like structures cellular material is the right term. For example, the oxide ceramic that is used for sieving the aluminium melt, can be termed as open cell ceramic filter not foam.

The most characteristic structural level of cellular materials is the macrostructure, namely the architecture. Most of the cellular materials are not transparent for light. Nevertheless, X-ray and neutron beams can be used to study the macrostructure. Radioscopy and tomography methods are applied to construct 2D and 3D images, respectively. The intensity of the beam, the resolution and speed of the detectors limit, for example tracking of the foaming process (liquid metal foams) or distinguishing objects below one micron (nanocellular materials). This issue, made by the cooperation of Hungarian, Austrian and German colleagues, is a non-exhaustive overview of cellular materials, highlighting some examination methods of the architecture, some group of the materials family and their properties. Some of the papers are comprehensive completed by new results; others focus on certain narrower scientific fields. By the editing we attempted to harmonize this multicolour style, coming from the comprehensive point of view towards the scientific details. Because of the interdisciplinary topic we hope that scientists from different fields will find interesting parts in this collection of papers. In this issue the foams will be introduced in more details. Furthermore, nanocellular materials as aerogels and ion implanted nanocellular surfaces will be discussed. The strong and withstanding matrix of metal foams opened new application fields as car-body elements, sound isolation panels and heat exchangers. Properties of metal foams will be discussed in more details. Through these papers a European group of materials scientist would like to introduce their results and perspectives to the Hungarian community.

Cellular Materials can be discussed in several aspects therefore we would like to open the possibility for continuation. It is well known that soap is stabilized by macromolecules. On the other hand solid particles stabilize beer foam, ice cream, froth during flotation and metal foam. Thus the particle stabilized foams are suggested for the most interesting follow up. Any comments, critics and suggestions concerning our recent and future activities as well as suggestions for cooperation are most welcome.