Media communiqué

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Materials research symposium in honor of retiring Empa Board Member Walter Muster

The father of nanotechnology research at Empa hands over to a new generation

Thirty five years ago Walter Muster commissioned Empa's first scanning electron microscope, in order to be able to investigate materials with the highest possible resolution. Today the institute has about a dozen electron microscopes and new developments in the technique mean that they now also cover the molecular and atomic levels. Scanning electron microscopes allow researchers to move individual atoms back and forth or to analyze surface layers only a few atoms thick – surfaces which lend materials new characteristics. "It's really great that this technology has progressed in such a way", said Walter Muster at the materials research symposium which was held in his honor at the Empa Thun on November 17th. In January 2007 Muster, a man who in his time has established countless research departments and programs, will retire and from then on his private life will have priority.

What do the Empa High Performance Ceramics Lab, the Functional Polymers Lab, the Empa Nanotechnology Research program, and even the Empa site in Thun have in common? They all shared the same midwife – Walter Muster. On the Empa staff since 1971, and a member of the Board of Directors since 1991, Muster has left his mark on the organization. No wonder therefore, that his "students" organized a farewell symposium in his honor at which the burning topics of discussion were research into modern materials and future developments and challenges in the world of material science.

The Empa has always oriented itself to meet the needs of industry and society, said Pierangelo Groening, Walter Muster's successor and recently appointed Board member, as he sketched the focal points of the institute's material research program for the next few years. "Humanity is confronted by enormous problems and the Empa can and must help to solve them." How are we going to meet the continually increasing energy requirements of the world's population, for example, and how are we going to prevent the environment from collapsing, Groening asked rhetorically. "We need to make sure we have clean power-trains ready to use, and we need to have new sources of energy at hand." There are already countless construction blueprints for planned fusion reactor ITER, "…but the materials that will be necessary, we don't have them yet." High time, therefore, to develop novel materials with the required characteristics, in Groening's opinion.

Developing materials by computer

A very promising area of research in this context is without doubt Computational Materials Science, so to say the virtual development of materials with the help of computer simulations. In order to develop new metal alloys with specific properties – for example new kinds of steel for steam turbine blades which can operate at over 600°C – Ulrich Klotz of the Empa's Joining and Interface Technology Laboratory is attempting to use computer modeling to predict the material properties of multi-component systems. The aim is to gather information on the optimal composition of the alloy and the heat treatment required. This is not a trivial procedure with alloys containing up to ten or more elements. For steel, aluminium, titanium and nickel alloys the computer modeling program named CALPHAD ("Calculations of Phase Diagrams") has already proved its worth. Currently Klotz is working on the development of another database for copper alloys. These form the basis of new kinds of solder or new so-called metallic glasses which have completely different properties in comparison to conventional metals.

Material scientists like diamonds too!

Olivier Beffort of the Materials Technology Laboratory is investigating a completely different kind of "alloy", in fact an aluminium-diamond mixture known as a diamond composite material. Beffort and his colleagues, in collaboration with industrial partners, are attempting to develop materials with extremely high thermal conductivities in the EU financed «Extremat» project («New Materials for Extreme Environments»). Such materials find use in aviation and space technologies as well as in the electronics field when it is necessary to conduct heat away from a component as quickly as possible. A typical application is for computer processors, since with increasing computing power these devices produce more and more heat which must be removed quickly, since the chips themselves can only operate up to about 150°C.

Today metals such as copper and aluminium are used as electrical conductors and also for applications where heat must be transported away from a location. For certain application, however, their coefficient of thermal conductivity is insufficient. Diamond has a thermal conductivity which is four to five times better, but unfortunately it has one disadvantage compared to metallic materials. "It is very difficult to make usable components out of diamond", says Beffort. For this reason the Empa researchers are working on the development of aluminium diamond alloys which are, in fact, nothing other than fine diamond particles embedded in an aluminium matrix. After some initial problems with the manufacturing process, Beffort's team has now succeeded in getting the diamond to adhere better to the aluminium, using among other techniques pretreatment of the diamond surface. The result is a novel material with a thermal conductivity in the required range, but which also has a thermal expansion coefficient allowing it to be used in combination with other materials.

High performance ceramics filter micro-organisms out of drinking water

Not only diamonds but ceramics too have astounding properties. Filters made of porous high performance ceramics are already being used in diesel motors to remove microscopic soot particles from the exhaust gas.

Thomas Graule is attempting to apply this principle to completely different particles, namely to pathogenic micro-organisms such as bacteria and viruses. Polluted drinking water continues to represent an enormous problem in developing countries. “Every year three million people worldwide die from the effects of microbiologically contaminated potable water. We want to help them”, say Graule. In collaboration with an industrial partner the ceramics researcher has recently applied for a patent to cover the Empa filter.

Other topics of discussion at the seminar included progress on the development of novel polymers which can be used to make light emitting diodes or for applications in solar technology, nano-coatings and their use for data storage purposes, and adaptive materials which change properties in response to their surroundings. All much to the delight of Walter Muster. “I think we can be proud of what Empa materials science has achieved over the last few years,” he says. That the dissemination of knowledge and dialog with the public enjoy a high priority at Empa is in no small measure due to Muster’s efforts. He was responsible, for example, in establishing NanoPubli two years ago, an exhibition on the topic of nanotechnology aimed at the public and organized under the auspices of the NanoEurope conference held annually in St. Gall. Not only did this cover the multitude of opportunities presented by the new technology, it also dealt openly with the possible risks involved. As Muster says, for an organization financed by the public coffers dialog with the wider population is after all a duty.

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Walter Muster, retiring Head of the Advanced Materials and Surfaces Department looks back during the materials research symposium with which the Empa organized in his honor of his forthcoming departure. (Photo: Christian Kauer, Thun)

Pierangelo Gröning, Walter Muster's successor as Head of the Advanced Materials and Surfaces Department will continue to orient its activities to meet the requirements of industry and society. (Photo: Christian Kauer, Thun)