Media communiqué

Materials Science & Technology

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National Innovation Briefing on «Smart Materials» at Empa

Investment in Intelligent Materials Pays Off

«Intelligent Materials and Systems» is a subject with a future – a fact on which both scientists and politicians are in agreement. However, in these times of economic crisis many Swiss firms are reluctant to invest in research and development, an attitude which the Innovation Promotion Agency (CTI) would like to change. The CTI, together with Empa, therefore invited industrial partners to a national Innovation Briefing on the topic of Smart Materials. The response was excellent, with over two hundred guests drawn from industry and research spending the day at the Empa Academy, being updated on the latest federal supportive measures and learning more about the National Research Program NFP 62 on Smart Materials. Specialists from Empa and other research institutions gave presentations on the newest research projects and showed where opportunities for science and commerce to cooperate might exist.

«We want to help SMEs, and indeed industry in general, to establish positions in the revolutionary market of the future – intelligent materials," was how Ingrid Kissling-Naef, the Director of the Innovation Promotion Agency, summarized the aims of the national Innovation Briefing which was held on August 13th. She firmly believed that the innovation theme has the potential to generate numerous new jobs and significantly strengthen the Swiss economy. The Innovation Briefings were initiated by the CTI and several have already taken place, dedicated to such topics as Clean Technologies for Energy and the Environment. They serve to bring together entrepreneurs and scientists with the aim of developing the outline of collaborative projects and taking the first steps in getting them under way.

Smart Materials offer solutions to many problems

Josef Keller, a specialist in technology transfer at the umbrella organization Swissmem, knows exactly how successful research partnerships are created. "Swiss researchers have earned a reputation for cutting-edge knowledge generation, but this does not automatically guarantee successful knowledge transfer because industry is first and foremost interested in finding solutions to its own particular, long-standing problems." This means that the first steps in a successful partnership are to make the right contacts and then build up a degree of trust, Keller explained to his audience drawn from the staff of firms in the mechanical, electrical, civil engineering and watch manufacturing industries, and the energy and medical technology sectors. There were plenty of opportunities at the gathering, held at the Empa Academy in Duebendorf, for attendees to get to know each other, ask questions and exchange ideas in the relaxed atmosphere of the cocktail reception or during the poster exhibition. Experts from the CTI, the Swiss National Science Foundation (SNSF) and

Empa's Technology Transfer Office were at hand to provide concrete tips regarding the availability of supportive funding. "Smart materials offer industry an elegant and tailor made response to a very broad range of questions," maintained Louis Schlapbach, President of the Leadership Group of the NFP 62 «Smart Materials» program, with conviction. These materials are called intelligent because they are capable of adapting optimally to their surrounding depending on the current conditions, he explained. "Smart materials change their physical, chemical or biological properties when subject to external stimuli. When the stimulus is removed, they return to their original state."

National Science Foundation and CTI offer financial and organizational assistance

One could imagine, for example, a screw made of smart materials for medical applications. A fifteen-year old with a broken leg as a result of a skiing accident does not need a stabilizing screw for the rest of her life – after the break has successfully healed it is superfluous. If an "intelligent" screw is used, then it can be given an external stimulus which causes it to detach from the surrounding tissue, thus making it much easier to remove surgically. In the Smart Materials program, which is led by Schlapbach and financed by the SNSF, funding to the tune of CHF 11 million is available over the next five years for projects based on similar ideas. Recently 27 of the 80 groups which submitted initial project outlines at the beginning of 2009 have been invited to prepare detailed proposals, including seven from Empa groups. What is special about the NFP 62 program is that if, after the initial phase, a project provides results which prove to be marketable then it will be recommended to the CTI for further support in a follow-on project with industrial partners. This is aimed at ensuring that research results do actually find their way into products or services which are marketed.

A wide range of potential applications

Engineers and material scientists from Empa and other research organizations presented short lectures in which they threw light on the various areas in which smart materials might find applications. "One of the nicest tasks for us engineers is to convert material properties cleverly and efficiently into functional properties which can be used to solve a particular practical problem and then to create an innovative product to do the job," maintained Paolo Ermanni of the ETH Zurich's Institute for Mechanical Systems who, together with Empa researcher Edoardo Mazza, is head of Empa's Adaptive Materials Systems Research Program. Applications range form intelligent systems for damping out vibration in the bodywork of cars, through smart materials for components used in space travel which can be monitored during flight, all the way to shape memory alloys which can be used for instance in valves, opening and closing at specific temperatures.

It is not just valves which can be controlled in this manner – novel optical lenses are also at the focus of the attention of smart materials researchers. The ETH startup firm Optotune develops lenses at Empa which can be shaped using "artificial muscles". The aim is to imitate the way in which the human eye functions. Traditional systems are based on rigid lenses which are positioned mechanically. Thanks to the use of electroactive polymers (EAPs) it is possible to change the shape of the lens itself, thus imitating the functioning of the human eye. The EAPs are activated by the application of an electrical voltage which shapes the lens to give the required curvature.

Artificial muscles are even capable of making fish fly! Recently an eight meter long airship floated through the halls of Empa buildings, moving like a trout through water. EAP actuators are mounted on the hull and the “fins”, and by switching the voltage on and off they are made to expand and contract. The “fish” moves elegantly and silently through the air at a speed of about one meter per second. This kind of airship would be particularly suitable for use as an observation platform for monitoring the environment or wild animals, for example. The principle can also be used to make peristaltic pumps.

Another area of application is for compliant systems, that is systems which are flexible and elastic such as those developed in the course of the Empa and ETH research initiative «kompliant.ch». These are flexible enough to allow large levels of deformation, yet strong enough to withstand large loads. These kind of intelligent materials make it possible to manufacture tools economically, from a single molding process. These tools are geometrically designed so as to support loads without using joints. In contrast to conventional mechanisms, their flexibility is not the result of rigid components sliding over one another but is based on the elastic deformation of the material.

And finally, in Empa’s Engineering Structures Laboratory a research group is using smart materials to successfully counter the effects of oscillation in stayed cable bridges. Together with industrial partners they have developed adaptive vibration dampers. These feedback-controlled “magnetorheological fluid dampers” (MR dampers) modify their damping effect depending on the extent to which the bridge cables are actually swinging. The greater the amplitude of cable oscillation, measured with a motion sensor, the greater the damping forces applied. This helps to avoid breakage of individual strands in the cable due to the effects of fatigue. The adaptive oscillation dampers have so far been installed on the Tudjman Bridge in Dubrovnik and on the Sutong cable stayed bridge over the Yangtze River in China.

Further information

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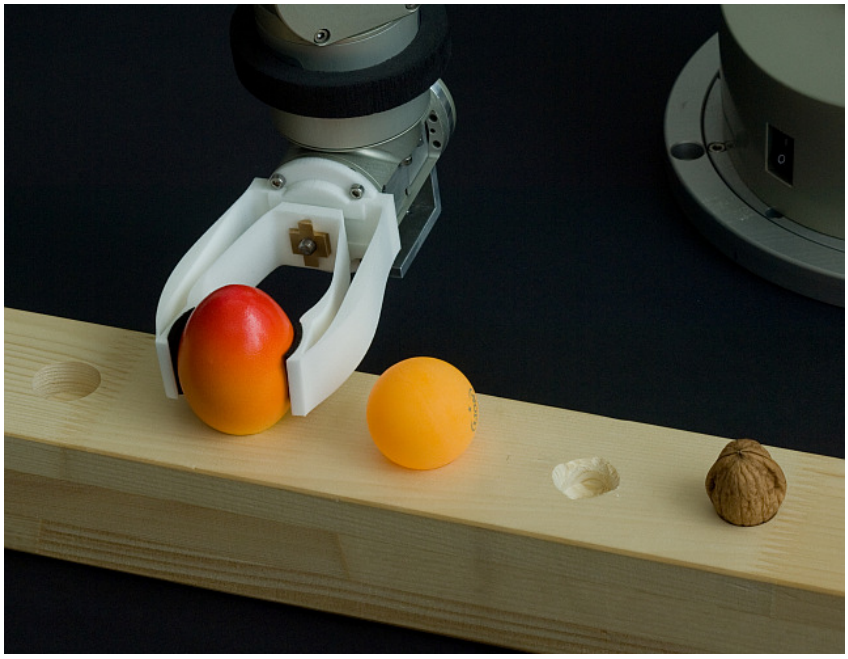

Economic tools can be made using intelligent, compliant systems. The gripping arm of this robot is made from a single molding process.

Empa's airship – the Blimp – moves like a trout through water. EAP actuators are mounted on its body and fins.

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