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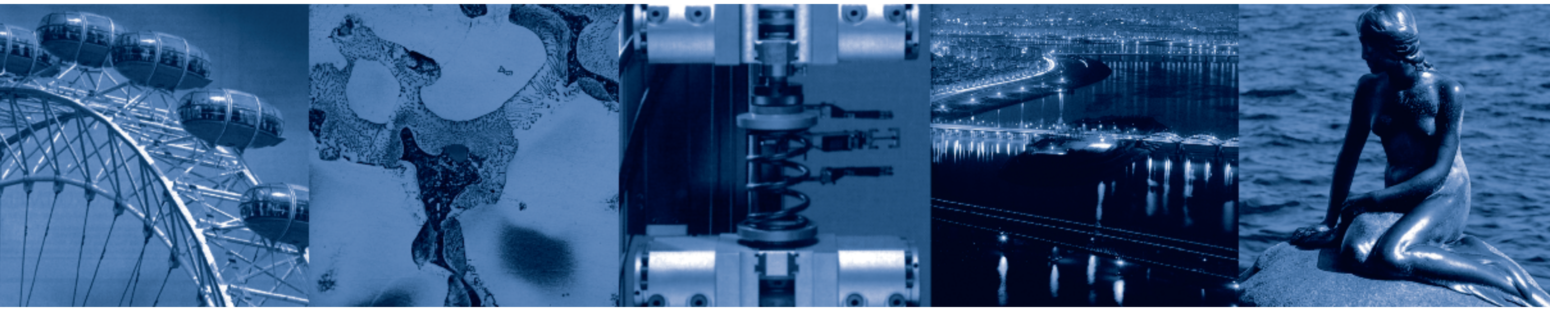

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It was said...

Luiz Inacio Lula da Silva
President of Brazil

"(...) As president, I have to be there for everyone. That's the strength of democracy. Someone who is elected by the people will pay as much attention to the needs of a banker as to those of a street child or a blue-collar worker by seeking a balance among their individual interests. In 2003, we had to make some very tough changes to our government finances, so that Brazilians can now enjoy more stability. At the time, I used part of the political capital that I had to get the country back in shape. (...)We have found a way to overcome poverty that isn't expensive at all. We provide financial support for young people so that they can go to school and learn a profession. We have also created a programme to help young people attend university. Some 400,000 poor young people – more than 40 percent of whom are black – who never had access to private universities in the past are now receiving grants. (...) We discovered immense oil reserves 273 kilometers off the coast, at a depth of 2,140 meters and under a 5,000-meter layer of salt and rock. We have the know-how to exploit these reserves. We expect to start test-drilling in March and start producing oil in 2010. Then Brazil will become a major oil exporter. We want to join OPEC and try to make oil cheaper. (...) Brazil has 33 years of experience with biofuels. The cars that are built in our country come with engines that can run on mixtures of gasoline and ethanol. They reduce CO_2 emissions considerably. The sugarcane plantations are cut for five years in a row. While the plants are growing, they capture carbon dioxide. The production is so cheap that it has no competition. (...) The production of fuel from basic food commodities is, in fact, unjustifiable. But it is the United States that uses corn for biofuel, which is then no longer available for food, while the Europeans derive energy from sugar beets, rapeseed and wheat. I have always told my European friends that it isn't worth restructuring their well-organised agricultural systems to produce biofuel. We, and the Africans, can do a much better job of it. The European Union should give the Third World a chance to produce biofuel. Besides, we should not forget that the higher cost of petroleum and fertilizers also contributes to the higher price of food. This is glossed over.(...) We have an abundance of land – 280 million hectares of farmland – as well as plenty of sun and water. Sugarcane is grown on only 3 percent of this area. Rich countries should stop subsidizing their own agriculture and lift their high import tariffs. (...)"

From SPIEGEL Interview with Luiz Inacio Lula da Silva President of Brazil on 10th May 2008

Editorial

Contemporary materials engineering deals with numerous engineering materials. Expect the most commonly used constructional materials, the important role is played by tool materials and so called special ones having physical and chemical properties relating to complex maintanance conditions of products made of them and their elements. The last decades are connected with the development of a special group of engineering materials called smart materials, although not rarely called also intelligent or adaptive ones. Smart materials are designed so that they can react to the external stimulation and may improve their properties adapting to their environmental conditions, extending their life, saving energy, or adjusting the conditions to improve human comfort, and also replicating themselves autonomously, repairing or damaging as needed, reducing waste and increasing efficiency. Currently, the materials mentioned above are called more and more often the multifunctional materials, as they react to the external stimuli in the intended way and as a result change their properties significantly and quickly enough. The smart materials, just like the automatic regulation systems fulfill therefore the functions of: a sensor (recording the external stimulation), a processor (analysing the changing environmental conditions) and an actuator (adapting its properties to the changed environmental conditions), demonstrating reversibility of these changes and the feedback function. Among the smart materials there are metal materials, ceramic, polymer, and composite ones, and this group grows rapidly.

One of examples of a system application of some smart materials and materials processing technologies and nanotechnologies connected with them is so called intelligent, that is highly technically advanced residential family and multi-family buildings and also office ones in which the achievements both of contemporary materials engineering and first of all automation and robotics and applied computer science are applied. The intelligent building is equipped with a system of detectors and management system integrated with installations being in it. Signals coming from various system elements, ensure the possibility of the system reaction on changes of external and internal environment in order to improve the building functionality and the safety of building, people and property being in it and in order to lower the costs of its exploitation and possible modernisation. The personification is ensured by adaptive learning or a direct system programmed by an operator taking into consideration needs and expectations of each user. It is difficult to imagine the building of contemporary skyscrapers not taking into consideration the conception of an intelligent building. It is simply impossible. It is thanks to the development of the constructions of skyscrapers, the conception of an intelligent building develops what requires the development of very many kinds of smart materials.

It is possible to point out many fields of contemporary technology in which smart materials are applied. Among others: astronautics, aviation, car construction, including cars, airplanes and railway, medicine, and especially surgery, control systems and automation and robotics, the broad range of mechatronics can be mentioned. The fundamental introduction of smart materials are discoveries of the magnetostriction phenomenon in 1842, piezoelectric phenomenon in 1880, employed in practice in the 1940s along with fabricating the barium titanate and discovery of the shape memory effect in 1962. The name of that group of materials comes from the 1980s and since that time their intensive development of the smart materials is dated.

Many groups may be mentioned among smart materials. A special one are shape meory alloys. These alloys are the material group being developed since 1962 when W.J. Buehler discovered this phenomenon in the Ni-Ti alloy. The specific properties of these alloys are connected with the reversible martensitic transformation. The martensitic transformation pertains not only to steel and Cu-Al alloys but has a more general nature and occurs in many metal alloys, some ceramic materials, and even in the cells of the living organisms. They are many alloys demonstrating memory effect. Employing the metal shape memory alloys in design of various machines and devices makes it possible to introduce new construction principles. Therefore, a significant simplification of the design is possible and miniaturisation of products, as well as reduction of their manufacturing costs.

Many of these alloys were implemented in practice in mass industrial production. One can name some examples from among many technical applications of shape memory alloys: permanent mechanical and electrical connections, temperature safety valves in gas grid, fire warning sensors, overheating protections for the electrical home appliances, control systems in water heaters, fuel and air supply control systems in car engines, fan shields, automatic window opening systems in greenhouses, actuator elements in the electrical circuit breakers, vibration and noise suppressing elements, pseudoelastic wires as composite fillers in high-pressure gas cylinders, spectacle frames, energy storing elements, heat engines, and elements of robots. Thermostatic bimetals can also be substituted with the shape memory metal alloys. Some of available shape memory metal alloys are used in medicine for short-time implants in surgery and orthopedics, whereas the Ti-Al alloys are used for the long-time implants. It is possible to select the chemical composition of the alloy so that the transformation and shape retrieval connected with it would occur at the patient's body temperature. The surgeon cannot then influence the final implant shape when using the implants with the transformation temperature higher than the human body temperature and with gradual delivery of heat from outside with the contact probe or with the resistance method one can control the extent to which the implant retrieves its initial shape. From the known shape memory alloys applications in medicine the following ones can be mentioned: clasps for osteosynthesis and rib fracture treatment, plates for osteosynthesis of, e.g. a jaw, arch wires in orthodontics, bone nails, Harrington bars and spacer sleeves for spine diseases treatment, clamps for aneurysms and blood clot filters. Implants from shape memory alloys make many operations more efficient and simplify them, and give the opportunity to introduce new operative techniques. The introduction of shape memory alloys resulted also in improvement of the technical level of the medical equipment. Such examples may be the design changes of the artificial heart or miniaturisation of the dialysis pumps. The contemporary applications of the shape memory alloys include also needles for breast tumour localisation, cores of guiding wires, stretchers used, e.g., as implants for distending the veins as a specific kind of a stent, surgical instruments and adaptive endoscopes with the shape adjusting to the patient's anatomical features during the operation or examination. Apart from the applications mentioned above, many new shape memory alloys application areas are found or are currently implemented. One may include to them applications in astronautics and aviation, due to significant adaptive capacity in zero gravity conditions. Therefore, these materials can be used for the self-deploying antennae, for operating the solar batteries shields, for reduction of vibrations and for joining pipes in spaceships, and for airplane wings geometry changes. In the automotive industry, apart from the pressure valves, these materials can be used for vibration attenuating pads and for devices switching the cooling or air-conditioning systems. These alloys can be used for the airtight closing of the industrial waste containers flaps should they set on fire, in the vibration damping devices in civil engineering, to prevent sagging of the electrical energy transmission lines, to compress the transformer cores, and also for plotter pen tips, in the air-conditioning valves and heater valves in flats and in the industrial premises, and also for the mobile phones self-deploying antennae with the required high gain.

Next attempts will come, undoubtedly, to use this material group, which poses more and more demanding requirements pertaining to their design and technology. An example of such activities are the research and development projects dedicated to working out materials demonstrating shape memory at temperature higher than to date, investigations of the magnetic shape memory, and also using these materials as matrix or reinforcement in composite materials. Due to the need to use shape memory metal alloys, among others, in the automotive industry, in refineries, and in protection equipment, it is necessary to search for alloys with the higher than to date temperature A_f of the end of the reverse transformation of martensite into austenite, which for the alloys presented so far does not exceed 120°C. Employment of shape memory alloys with a higher temperature A_f makes the increase of the material cooling rate and of the frequency of changes possible which is connected with the increase of the service frequency. In some materials big deformation reaching 8% may occur under the influence of the external magnetic field. The phenomenon, called the magnetic shape memory is connected with reorientation of martensite due to the movement of the twin boundaries between the particular martensite types under the influence of the magnetic field. The movement of the magnetic domains walls occurring due to magnetization causes the movement of domains in the structure. The strongest magnetic shape memory effect occurs in Heusler's alloy with the approximate chemical composition.

Currently the magnetostriction materials are flourishing albeit the magnetostriction effect was discovered by J.P. Joule only in 1842. They have found many applications, among others in seismic sensors, geological tomography, in sonars, movement, load, and magnetic field sensors, variable geometry mirrors, fuel injections systems and hydraulic valves, industrial cleaning systems and other devices which do not have to be of miniature sizes. Such materials may be also used in aircrafts to actuate wing geometry changes depending on flight speed, for vibration attenuation devices in aircrafts, for surgical instruments or acoustic devices, and also in systems monitoring condition of elements made from composite materials in service. As the new magnetostriction materials are developed, the range of their applications grows and there are more applications of such materials in the industrial control and automation systems. Other smart materials include the piezoelectric materials, electrostriction, electro and magnetorheological (liquids), electrochromical, fibre optic and chiral ones (optically active), and tunable dielectrics.

In the next Issues of Archives of Materials Science and Engineering papers concerning that group of engineering materials in numerous practical applications appear. That subject matter is usually original and modern that is why constantly interests P.T. Readers. Therefore, we invite the P.T. Authors to publish their scientific contributions from this area in our journal. I dare to pay your attention to the fact that the World Academy of Materials and Manufacturing Engineering WAMME, which is at present the main scientific patron of our Journal, organises on 22^{nd} – 25^{th} June 2008 in Ryn near Olsztyn in the Region of Thousand Lakes, called Masuria the successive 16^{th} International Scientific Conference on Achievements in Mechanics and Manufacturing Engineering AMME'2008. As usual ca. 200 delegates from ca. 40 countries of the world announced their participation. During that conference also sessions concerning smart materials are foreseen. I wish all the conference delegates the nice stay in Poland and interesting discussions during sessions and behind the scene.

Prof. Leszek A. Dobrzański M. Dr hc
Editor-in-Chief of the AMSE
President of the WAMME
President of the ACMS&SE

Gliwice, in May 2008