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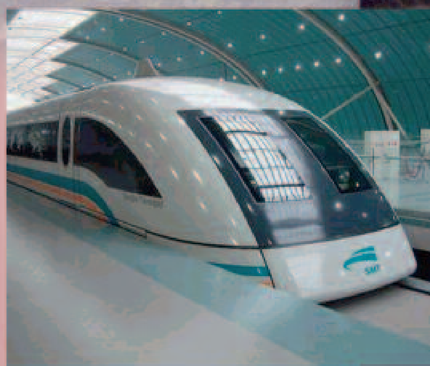

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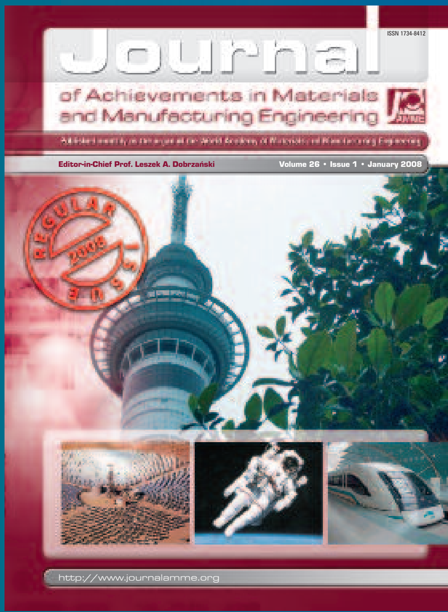
Cover story



The TV tower in Auckland, New Zealand shown on the cover suggests associations with the state-of-the-art engineering materials used in TV technique, but also with electronic materials and the ones for optoelectronics used there and in general with the smart materials ... Discovery 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 which gave rise to the smart materials (intelligent materials, adaptive materials), whose name comes from the 1980s and since that time their intensive development is dated. The 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 a result change their properties significantly and quickly enough. The smart materials, just like the automatic regulation systems fulfil 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.

Many groups may be distinguished among the smart materials, and a special one are the alloys with the shape memory. 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 reversible martensitic transformation consists in the repeated martensite transformation into its parent phase (austenite) during heating up. This transformation begins at As (austenite start) temperature and ends at Af (austenite finish) temperature. 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. The spontaneous and irreversible martensitic transformation occurring in steels is only one of its many varieties. They are many alloys demonstrating memory effect, including: Ag-Cd, Au-Cd, Cu-Al-Ni, Cu-Sn, Cu-Zn, Cu-Zn-X (X = Si, Sn, Al), In-Ti, Ni-Al, Ni-Ti (nitinol), Fe-Pt, Mn-Cu, Fe-Mn-Si.

Employing the metal alloys with shape memory 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 orthopaedics, 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 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.