DEMAND ON MAGIC METAL

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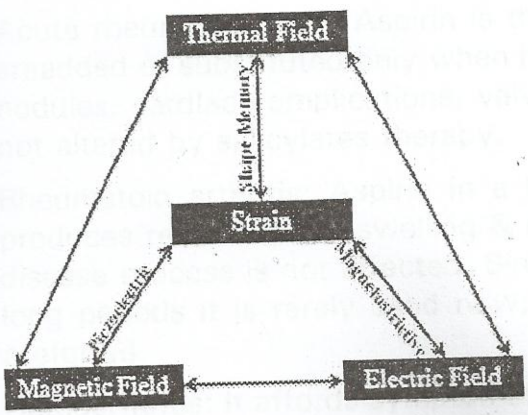
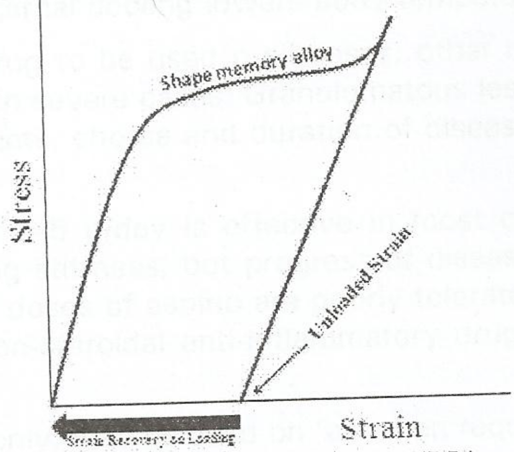
Shape memory alloy (SMA), which is known as Magic metal have attracted a lot of research interest in recent decade. SMA responds to things that happen around them. The shape memory effect for which it is named is the ability of the material to undergo thermally recoverable deformation. These are advance class of alloys, found a variety of applications in recent years due to its unique behavior under mechanical and thermal loads and can recover apparent permanent strains on the order of ~10% strain when they are heated above a certain temperature. These alloy have two stable phases, first one is the high-temperature phase, called austenite (named after English metallurgist William Chandler Austen [1]) and the low-temperature phase, called martensite (named after German metallographer Adolf Martens [1]). The shape memory effect was discovered in a gold-cadmium alloy by Arne Olander in the 1930s, but practical shape memory alloys (also called smart metals, muscle wires, and memory metals) only started to become popular in the early 1960s after the development of nitinol at the US Naval Ordnance Laboratory (nitinol actually stands for *Ni*ckel *Ti*tanium *N*aval *O*rdnance *L*aboratory). When an SMA is below its phase transformation temperature, it possesses a low yield strength crystallography (Martensite) and in this state, the material can be deformed into other shapes with relatively little force. The new shape is retained provided the material is kept below its transformation temperature. When heated above this temperature, the material reverts to its parent structure (Austenite) causing it to return to its original shape.



Different Mediums Influence on Shape Recovery



Stress-Strain Relation on SMA

The potential for use of SMAs in engineering structures is limited by the range of temperatures within which phase change may take place and the rapidity with which these changes occur and most important factor is of higher cost. Many experiments exist based on the principle of using shape memory alloy element as a thermal actuator which converts thermal energy into mechanical work. Recent interest in the development is concentrated on iron-based alloys such as Ni-Mn-Ga, Ni-Mn-Sn, Ni-Mn-In, Co-Ni-Al, Co-Ni-Ga, Ni-Al-Fe, Ni-Fe-Ga, Cu-Zn-Al etc. In the 1990s, materials scientists started developing inexpensive plastics with properties similar to shape-memory alloys, Known as shape memory polymers (SMPs), they are likely to expand hugely than that of shape memory materials. Also a group of scientists has discovered a plastic that changes shape by applying light. With this discovery new possible applications were introduced (i.e. photosensitive switch) [2]. Both the shape memory effect and the superelastic properties of SMAs are currently being utilized in applications that require structural, sensing, and actuating materials. The shape memory effect is well-suited for tube couplings, robotic limbs, and electrical connectors, air flow controls for air conditioners, thermostatic mixing valves and bone plates. Superelastic applications include headphone headbands, eyeglass frames, reinforcing wire in shoe heels, and orthodontic arch wires. Unlike metals and traditional alloys, shape memory alloys are strong *and* flexible, easy to sterilize, and corrosion-resistant too. In an experiment there is the application of cryogenic treatment with SMAs to improve the property of different alloys. Now-a-day it is trying to improve properties of these alloys or finding different alloys with better properties and these researches leading to form "Shape Memory Alloy Age". □

References :

[1] Srinivasan A. V., McFarland Michel D., Smart structures – analysis and design, Cambridge University press (2001), pp. 26–69

[2] Thomson E. A., "Intelligent plastics change shape with light", MIT Tech Talk, Vol. 49, No. 25, April 2005, pp. 5