UNIT V

CHAPTER 2

SMART MATERIALS

SMART MEMORY ALLOYS(SMA)

The smart memory allows (SAMs) are a class of materials that can change shape when subjected to a temperature change or an applied force. They have the ability to return to their original shape once the stimulus is removed. This property Is called the shape memory effect and it is due to the presence of a microstructure that can be trained to retain a particular shape.

SMAS is commonly made of alloys of nickel, titanium, and copper and they can have a wide range of potential applications, such as in the aerospace biomedical, and robotics industries. They can be used to make actuators, sensors, and other devices that require high-precision movement(or) force control. One of the key advantages of SMAs is that can generate a large amount of force relative to their size and weight, making them useful in applications where space and weight constraints are important.

Additionally, they are relatively durable and have a long lifespan compared to other actuator materials.

Smart memory alloys (SMAS) possess several unique properties including:

1. Shape memory effect: SMAS have the ability to recover their original shape after being subjected to external stress (or) temperature change. this is a result of their microstructure, which can be trained to remember a particular shape.
2. Large force generation: SMAs can generate a large amount of force relative to their size and weight, making them useful in applications that require precise movement (or) force control.
3. Durability: SMAS is relatively and other durable have a long life span compared to actuator materials, making them ideal for use in harsh environments.
4. Temperature sensitivity: SMAs are sensitive to temperature changes and their properties can be affected by various in temperatures. This property makes them useful for temperature-sensing applications.

5. Good corrosion resistance: many SMAS has good resistance, which makes them suitable for use in harsh environments or in biomedical applications.
6. Biocompatibility: some SMAS have been shown to be biocompatible, making them suitable for use in biomedical implants and devices.
7. Lightweight: SMAS is lightweight, which makes them useful in applications where weight reduction is important, such as in aerospace an robotics.
8. High stiffness: SMAS have high stiffness which is important in applications that require precise movement (or) force control.

Shape memory alloys (SMAs) are metallic alloys that when severely deformed at some relatively low temperature, regain their original shape after a thermal (heating/cooling) cycle.

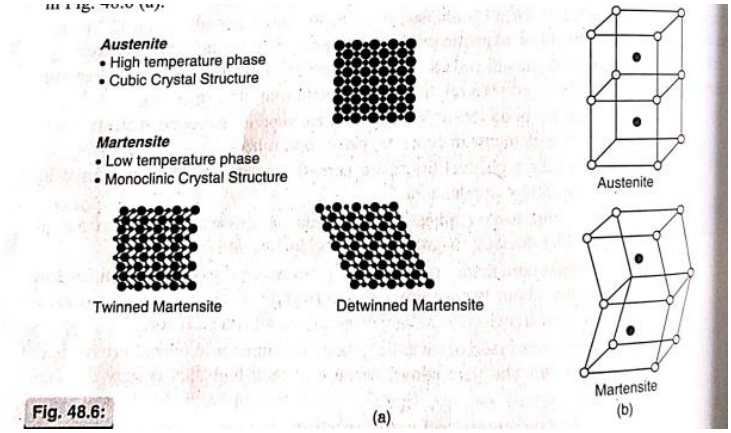
TWO PHASES

There are two stable solid phases that occur in shape memory alloys. They are

i)the high-temperature phase, called austenite.

ii) the low-temperature phase, called martensite.

These two phases have geometrically different crystallographic elementary cells(see fig). the martensite can be in one of two forms: twinned and detwinned, as shown in fig



Different phases of an SMA

Martensite is a crystallographic less-ordered phase and therefore is the softer and easily deformed phase of shape memory alloys. This phase exists at lower temperatures. The martensite structure is self-accommodating, and the deformation on transformation to martensite is zero.

Austenite is a more-ordered phase and hence the stronger phase of shape memory alloys it occurs at higher temperatures. The shape of the austenite structure is cubic. The twinned martensite phase is of the same size and shape as the cubic austenite phase on a macroscopic scale. Change in size or shape becomes visible in shape memory alloys when the twinned martensite is detwinned, which is deformed.

A phase transformation that occurs between these two phases upon heating/cooling is the basis for the unique properties of the SMAs. The phase transformation may occur due to the temperature, the mechanical load applied, or due to both temperature and load. The key effects associated with the phase transformation are the shape memory effect and pseudo elasticity.

SMA-APPLICATIONS:

1. It is used indestructible spectacle frames.
2. Medical, aerospace, etc. are used widely in SMA.
3. “vena-cava” is the device used to track the blood flats.
4. And the main application is it is used in dental and orthodontic wires
5. Stents for veins is a device used to treat the coronary diseases.