University Of Technology- Iraq
Department of Materials Engineering
General Materials Branch
Fourth class

Smart Alloys

Lecture 1 : Introduction

Class Code on Google Classroom :2shhens

Class Objectives

Benjamin Franklin said:

- *- Tell me, I will forget,*
- *- Teach me, I will remember,*
- *- Involve me, I understand*

References

- Schwartz. Mel, Smart Materials , John Wiley and son ,New York ,USA, 2010
- Otsaka and Waymen ,Shape Memory Materials , Cambridge University Press , UK , 1989
- Lecce , Roberto ,Shape Memory Alloys Engineering ,2nd edition, Butterworth - Hiennham , Amsterdam , Netherland 2017
- Bahera . Ajet , Advanced Materials , 1st edition , Springer, Germany ,2019
- Karana .Evilyn, Materials Experience , Butterworth - Hiennham , Amsterdam , Netherland 2014
- Schwartz .Mel , Encyclopedia of Smart Materials , John Wiley and son New York, USA , 2016

توزيع الدرجات

Terms	Grade
Mid Term	20%
Quiz	5%
Assignment	5%
Final	70%

Course Subjects

- Shape Memory Alloys
- Piezoelectric Materials
- Biomimetric Materials
- Smart fluid
- Magnatostrictive materials
- Electrostrioctive Materials

What are smart materials?

- **Smart materials** are materials that have one or more properties that can be significantly altered in a controlled fashion by external stimuli, such as **stress**, **temperature**, **moisture**, **pH**, **electric** or **magnetic fields**

What is Smart Behavior

- Smart behavior occurs when a material can sense some stimulus from its environment and react to it in a useful, reliable, reproducible and usually reversible manner.

Classification of Smart Materials

1. Piezoelectric
2. Electrostrictive
3. Magnetostrictive
4. Shape memory alloys
5. Magnetocaloric
6. Electrochromic materials
7. Fullerences
8. Biomimetric materials

Classification of Smart Materials

CLASSIFICATION OF SMART MATERIALS

Type of SMART Material	Input	Output
Piezoelectric	Deformation	Potential Difference
Electrostrictive	Potential Difference	Deformation
Magnetostrictive	Magnetic Field	Deformation
Thermoelectric	Temperature	Potential Difference
Shape Memory Alloys	Temperature	Deformation
Photochromic	Radiation	Color Change
Thermochromics	Temperature	Color Change

PROPERTIES OF SMART MATERIALS

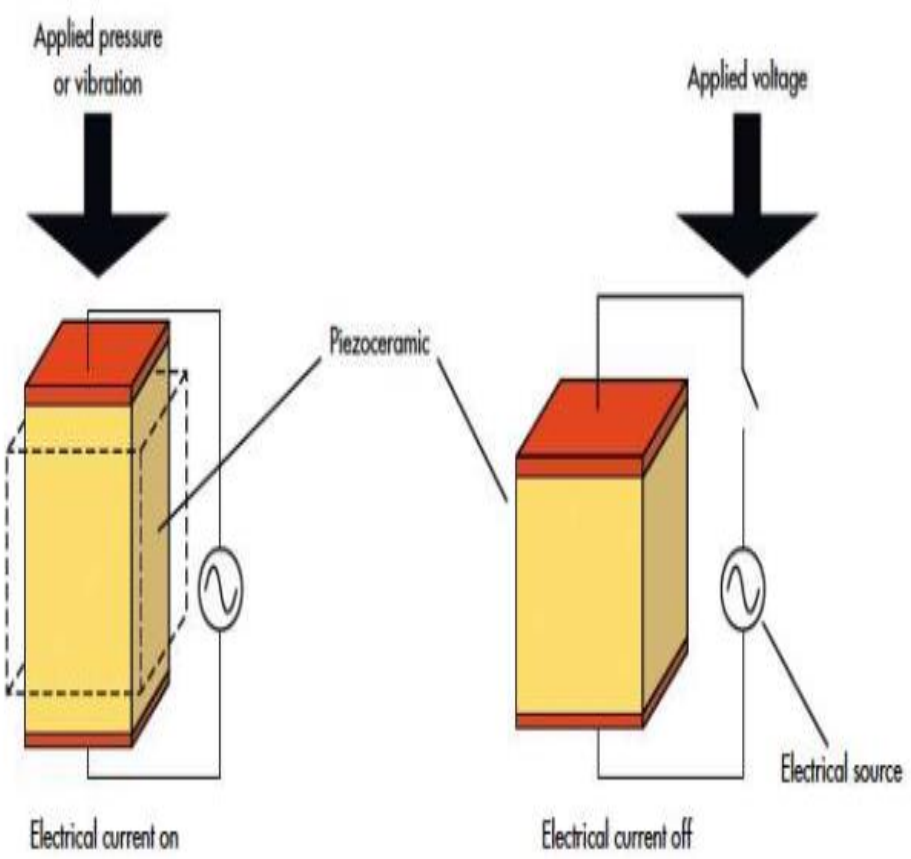
1. Sensing materials and devices
2. Actuation materials and devices
3. Control devices and techniques
4. Self-detection, self-diagnostic
5. Self-corrective, self-controlled, self-healing
6. Shock-absorbers, damage arrest

Smart materials

- Smart materials have properties that react to changes in their environment.
- This means that one of their properties can be changed by an external condition, such as temperature, light, pressure or electricity.
- This change is reversible and can be repeated many times.
- They are often also called “responsive” or “intelligent” materials.

Piezoelectric Materials

- When subjected to an electric charge or a variation in voltage, piezoelectric material will undergo some mechanical changes.
- The best known example is electric cigarette light



Electrostrictive Materials

- This material has the same properties as piezoelectric material, but the mechanical change is proportional to the square of the electric field.
- Lead Magnesium Niobate (PMN) and its doped derivatives are classical electrostrictive

Merits and Demerits

Merits

1. Bio-compatibility
2. Simplicity
3. Compactness
4. Safety mechanism
5. Good mechanical properties

Demerits

1. More expensive
2. Low energy efficiency
3. Complex control
4. Limited bandwidth

Advantages of Smart Materials

1. High energy density (compared to pneumatic and hydraulic actuators)
2. Excellent bandwidth
3. Simplified packaging
4. Novel functions such as the huge volume change as a
5. function of temperature exhibited by smart gels.

Disadvantages of Smart Materials

1. Dropping people out of the labor
2. Not biodegradable
3. Environmental pollution
4. Expensive to produce
5. Long term effects unknown Global crisis