



UTTAR PRADESH TEXTILE TECHNOLOGY INSTITUTE, KANPUR

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| FACULTY N NAME: | ARPIT SRIVASTAVA |
| SUBJECT: | MATERIAL SCIENCE |
| BRANCH: | TT & TE |
| SEMESTER: | IV |
| TOPIC: | UNIT 5 : SHAPE MEMORY EFFECT |
| SESSION : | 2019-2020 |

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TOPIC

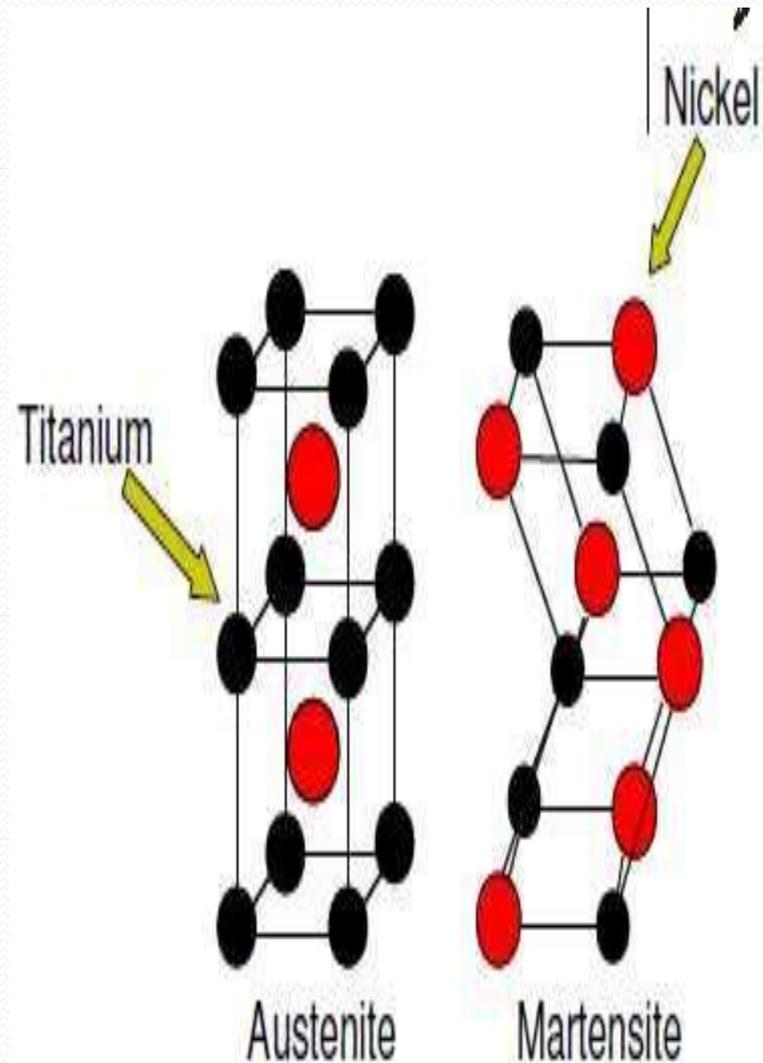
- 1.HISTORY OF SMA
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1.HISTORY OF SMA

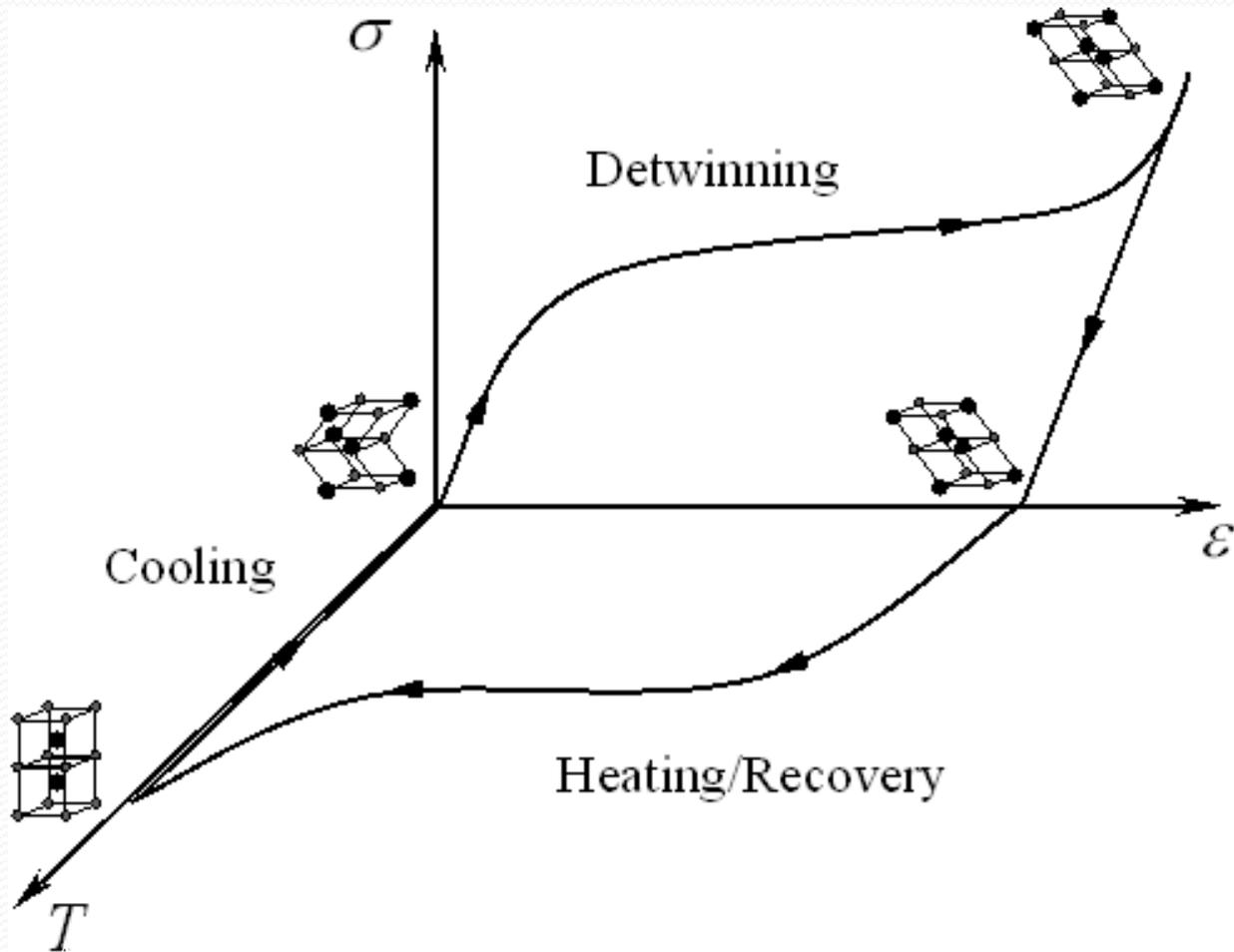
- SMAs were first discovered in 1951
- Further publicized after the discovery of Ni-Ti alloy in 1963
- SMAs have two main phases: Austenite and Martensite
- Austenite phase is Symmetric,while martensite phase is less symmetric
- Phase transformation occur either thermally of mechanically

2.INTRODUCTION

- Shape Memory Alloys (SMAs) are a unique class of metal alloys that can recover apparent permanent strains when they are heated above a certain temperature.
- The SMAs have two stable phases - the high-temperature phase, called austenite and the low-temperature phase, called martensite

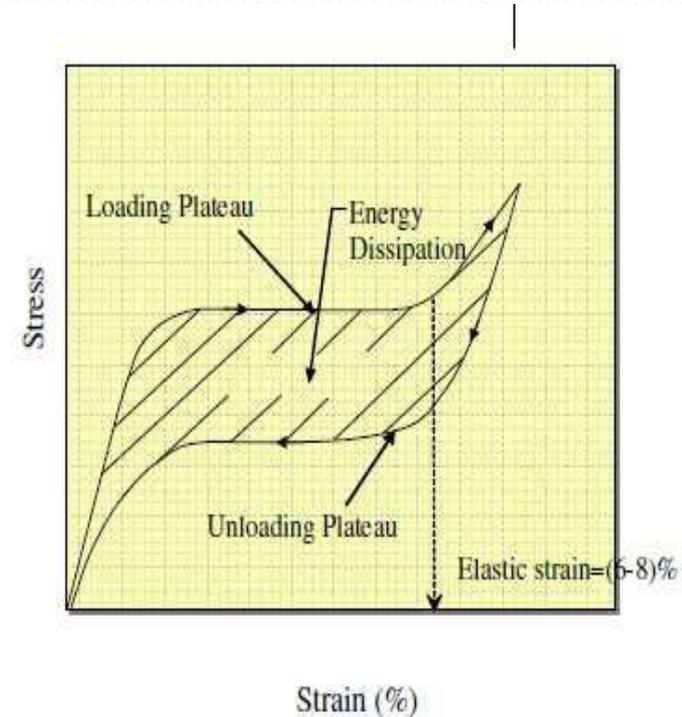


3. SCHEMATIC DIAGRAM UNDER TEMPERATURE



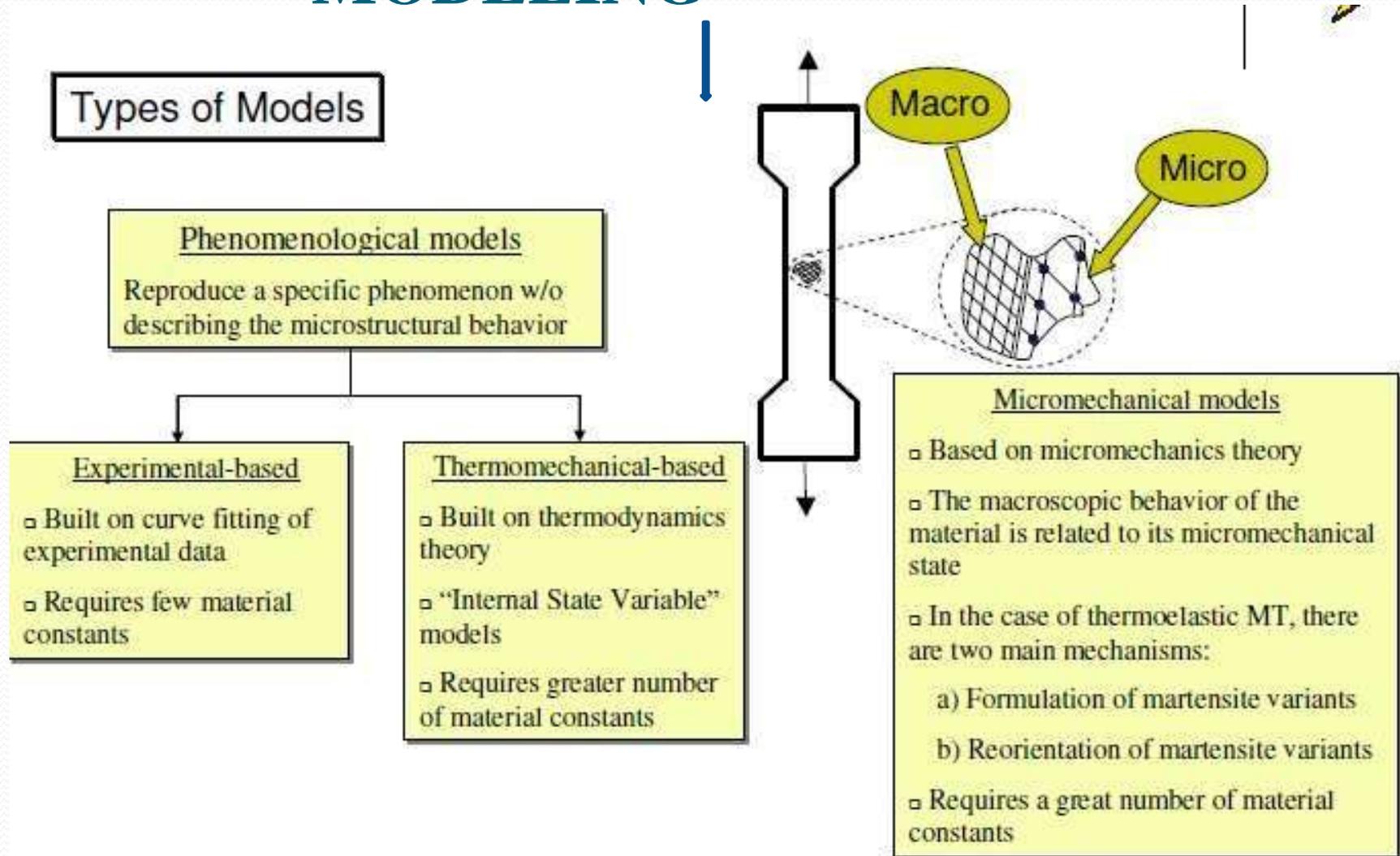
4. SUPERELASTIC SMAs

- Super elastic SMAs are characterized by:
 - 1) Excellent recentering capability
 - 2) Controlled level of force at moderate strain levels
 - 3) Strain hardening at large strain levels
 - 4) Hysteretic energy dissipation
 - 5) Excellent corrosion resistance
 - 6) High fatigue strength



Casati, R., Passaretti, F., & Tuissi, A. (2011). *Effect of electrical heating conditions on functional fatigue*.

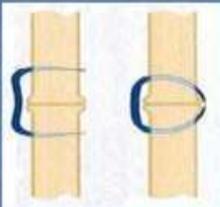
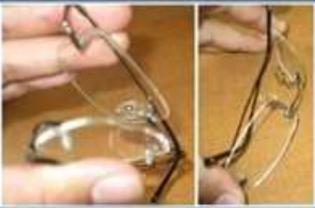
5. SHAPE MEMORY ALLOYS: MODELING



6. Applications:

- Various thermal actuators then came into existence as a part of electric appliances and automobile engineering.
- Automobile
- Aerospace application
- Bio medical
- Civil engineering of Mega structures

Applications of Shape Memory Alloys (SMAs)

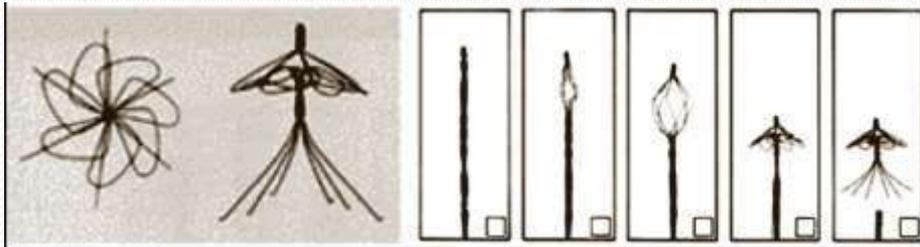
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|--|---|--|---|---|
|  F-14 |  |  |  |  |
| Aeronautic coupling & Solid-state actuator | Orthodontic archwire | Endodontic SMA tool | Self-expanding SMA stent | SMA bone staple |
|  |  |  |  |  |
| Robotic gripper | SMA spring | Eyeglass frame | SMA thin film & MEMS | SMA art application |

7. FUTURE APPLICATIONS OF SMA

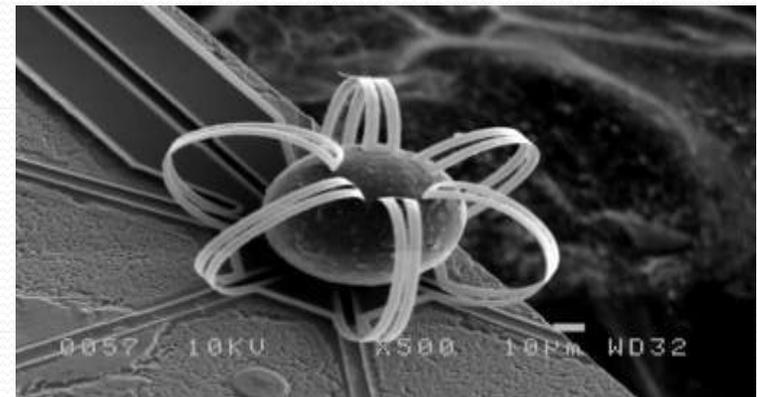
- Eliminate vibrations of read/write heads in hard disk drives
- Microstents
 - Promote flow in tubular passages
 - Reinforce weak blood vessels
- Microsurgery
 - Cardiovascular applications
 - Orthopedic applications



microstents



Simon filter



Micro wrapper

8. ADVANTAGES

- High strength
- Good elasticity
- Fatigue Resistance
- Wear resistance
- Easy fabrication
- Easy to sterilize
- High Power/weight ratio
- Light weight
- Shape memory

Cont...

- Grab tiny foreign objects for removal from the body
 - □ Facilitates access to intricate regions of the body
- Micro assembly for MEMS devices
- Intravascular catheters



(ASSISTANT PROFESSOR)

9. DISADVANTAGES OF SMAs

- The main disadvantages of SMA's are:
 - Initial Expensive
 - Sensitivity of material properties in fabrication.
 - Residual Stress's developed in thin films.
 - Nonlinearity of actuation force.
 - Lower maximum frequency compared to other micro actuator devices.
 - Poor fatigue Property.

10 CONCLUSION

- SMA's have the potential to be used effectively in seismic regions.
- The high cost of SMAs is a major limiting factor for its wider use in the construction industry.
- Their capability to allow the development of smart structures with active control of strength and stiffness and ability of self-healing and self-repairing opens the door for exciting opportunities, making them the construction material of the future.

Thank you

