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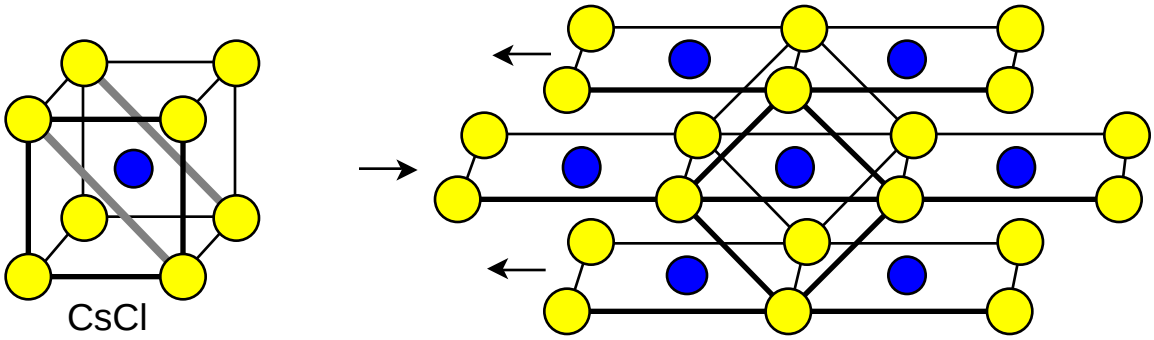
Laboratory Safety

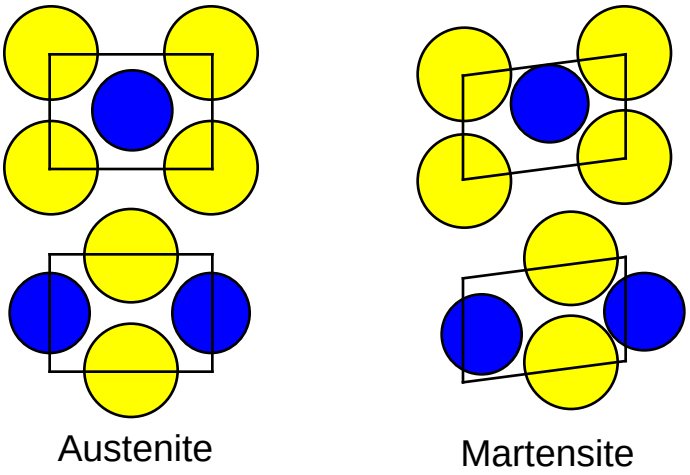
DISCLAIMER

Safety information is included in each chapter of the Companion as a precaution to the readers. Although the materials, safety information, and procedures contained in this book are believed to be reliable, they should serve only as a starting point for laboratory practices. They do not purport to specify minimal legal standards or to represent the policy of the American Chemical Society. No warranty, guarantee, or representation is made by the American Chemical Society, the authors, or the editors as to the accuracy or specificity of the information contained herein, and the American Chemical Society, the authors, and the editors assume no responsibility in connection therewith. The added safety information is intended to provide basic guidelines for safe practices. Therefore, it cannot be assumed that necessary warnings or additional information and measures may not be required. Users of this book and the procedures contained herein should consult the primary literature and other sources of safe laboratory practices for more exhaustive information. See page xxv in the Text 0 Preface file in the Companion Text folder for more information.

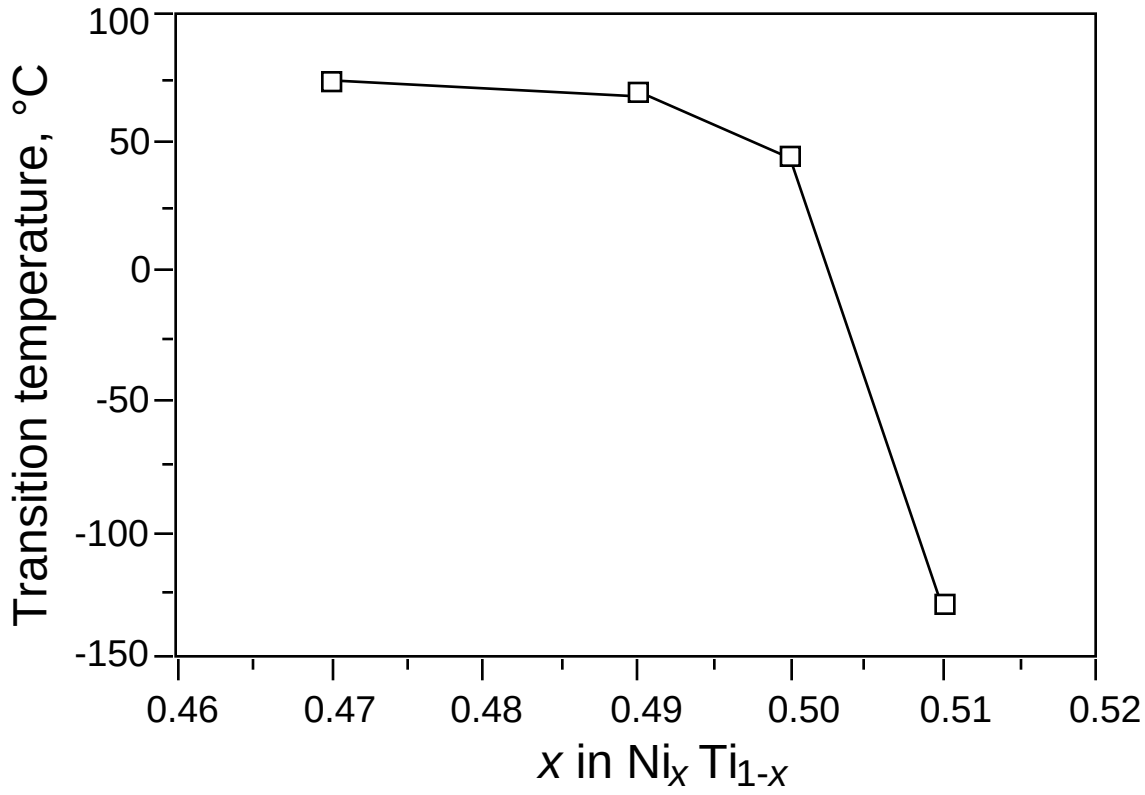
NiTi Solid-State Phase Transition



Representation by layer sequence in the unit cell:



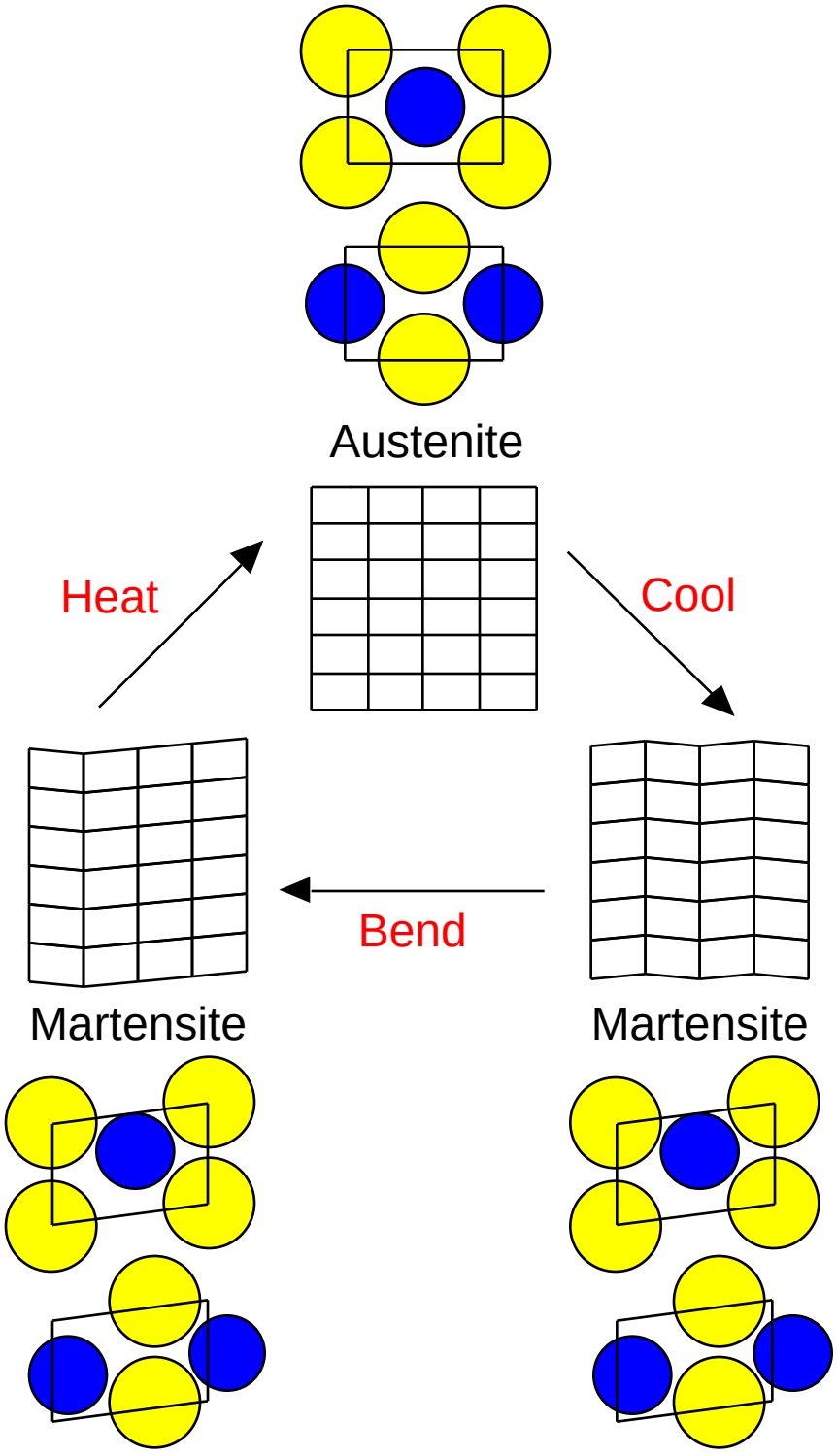
Phase Transition Temperature and Composition



A 2% change in composition varies the transition temperature by 150°.

By varying the composition, either phase can be present at room temperature.

Shape Memory Cycle



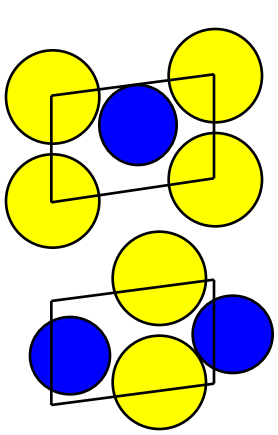
Le Chatelier's Principle

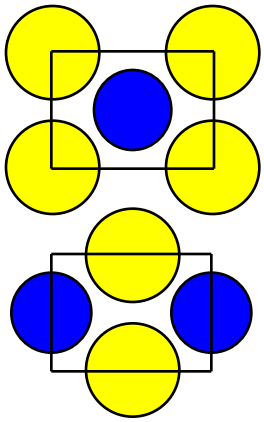
heat + $H_2O_{(l)}$ ⇌ $H_2O_{(g)}$

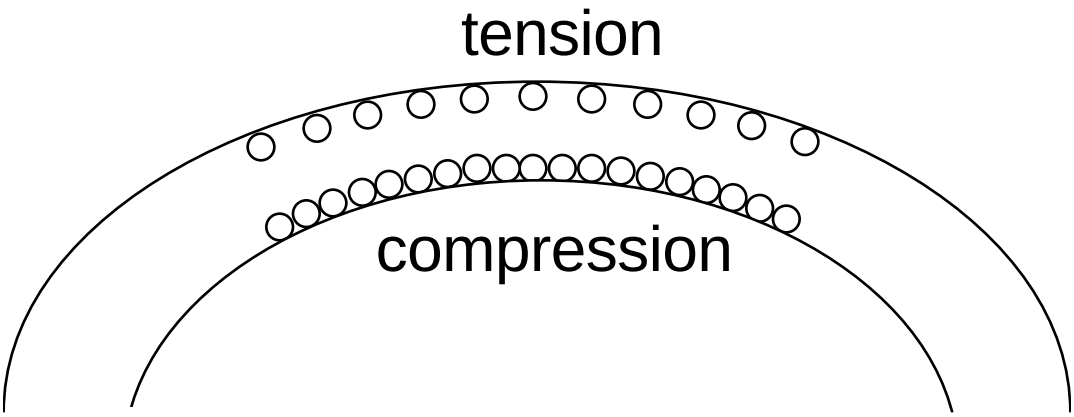
high density
low volume

low density
high volume

heat + martensite ⇌ austenite

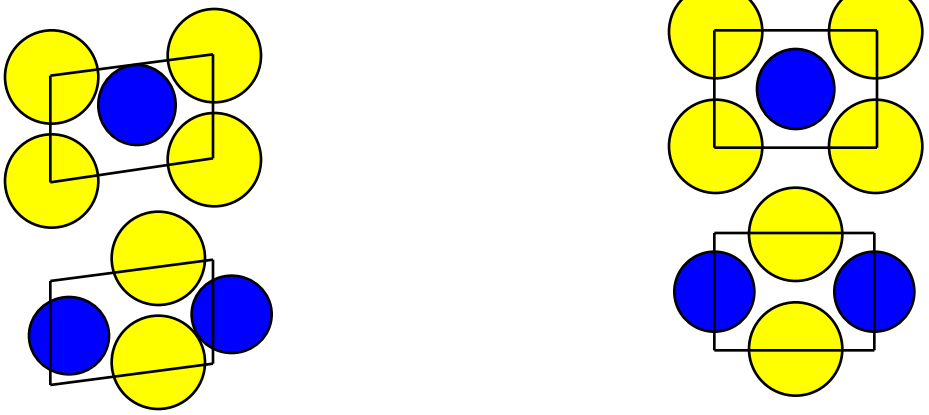






as P ↑, equilbrium shifts ⇌

NiTi Properties



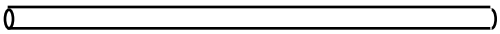
energy + martensite ⇌ austenite

higher density
lower volume

lower density
higher volume

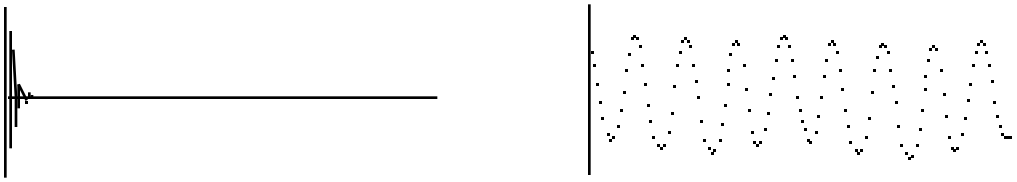
Superelasticity: stress or pressure, shifts the equilibrium to the left; it shifts back when pressure released

Bends readily



Very rigid

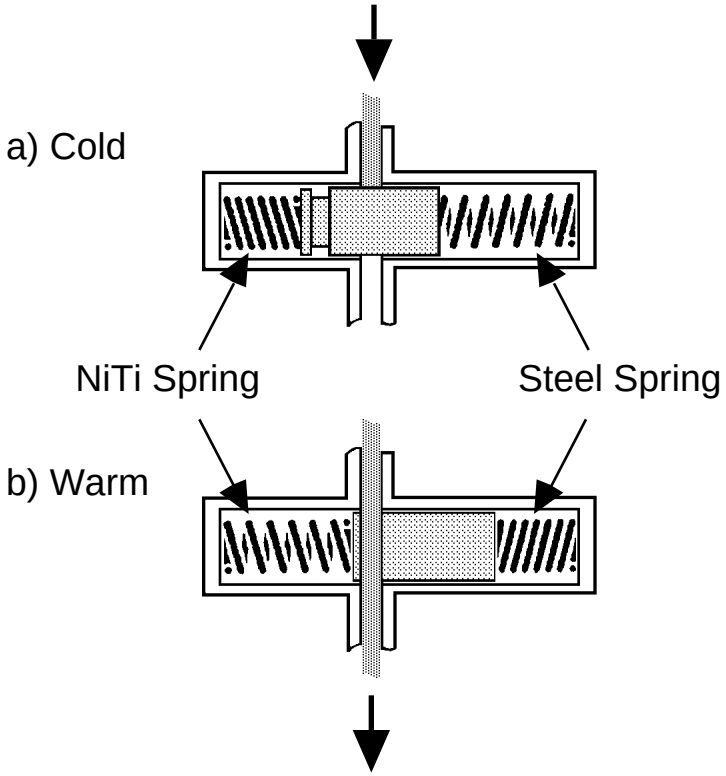
Ease of deformation arises from ability to realign different variants of the martensite structure.



Sound propagates more readily through the more symmetric austenite structure.

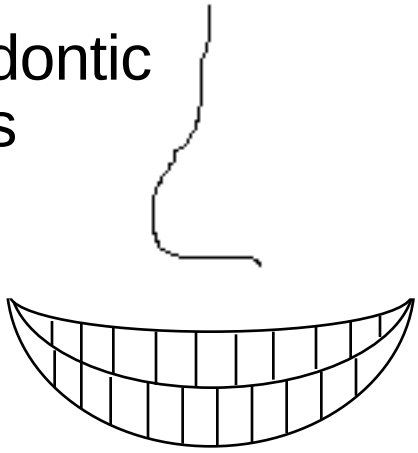
NiTi Commercial Applications

Diesel Mercedes transmission fluid valve



Eyeglass frames

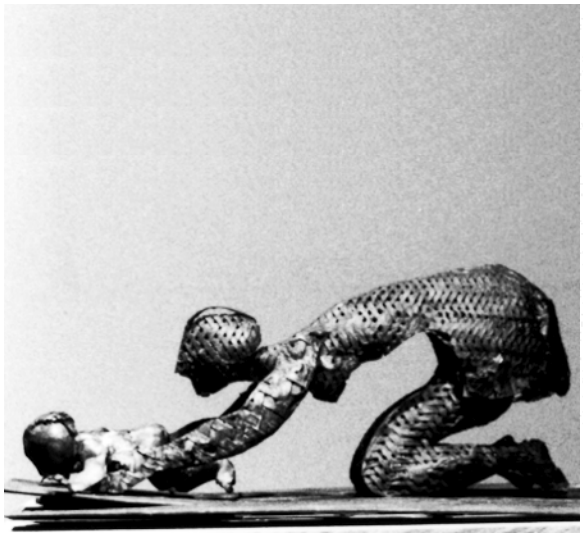
Orthodontic braces

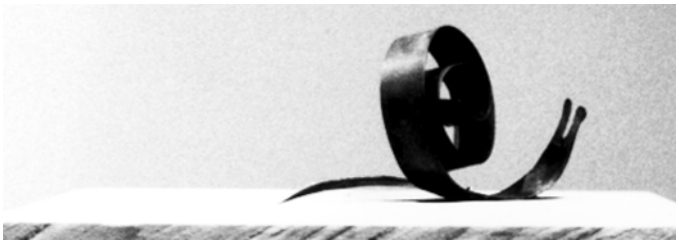


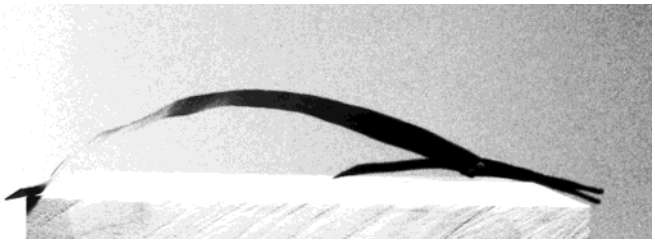
Anti-scald faucets

Surgical staples

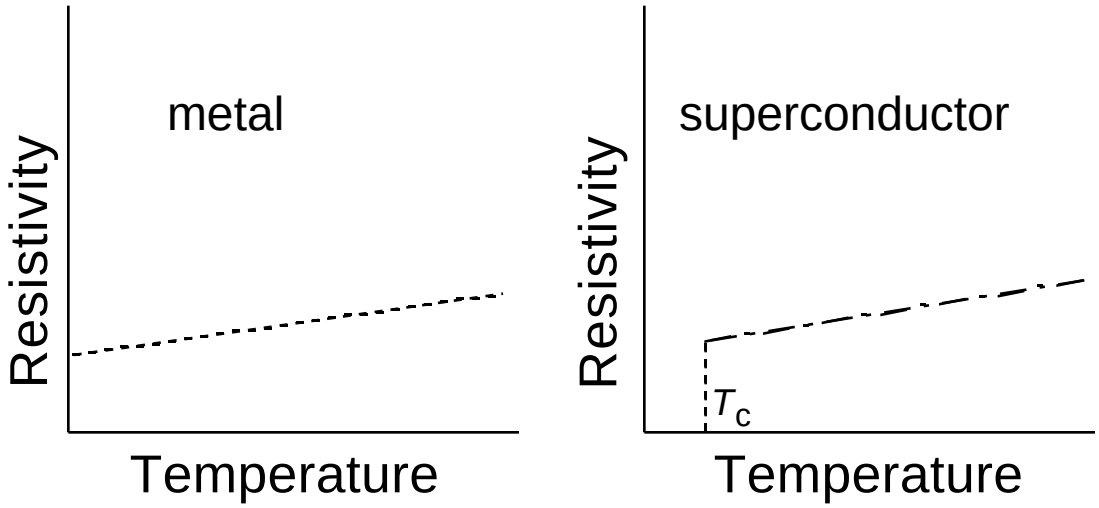
NiTi Sculptures
by Olivier Deschamps



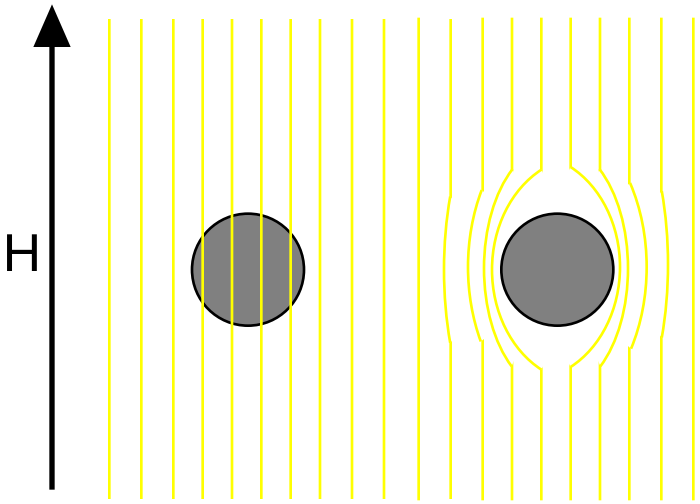


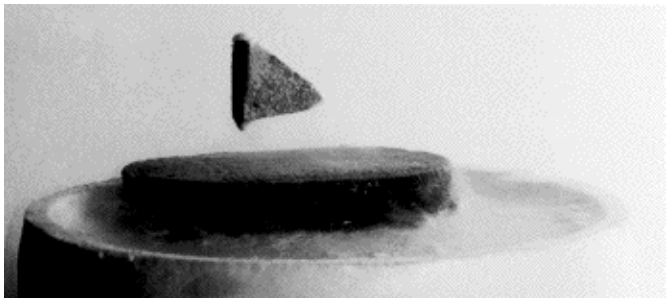


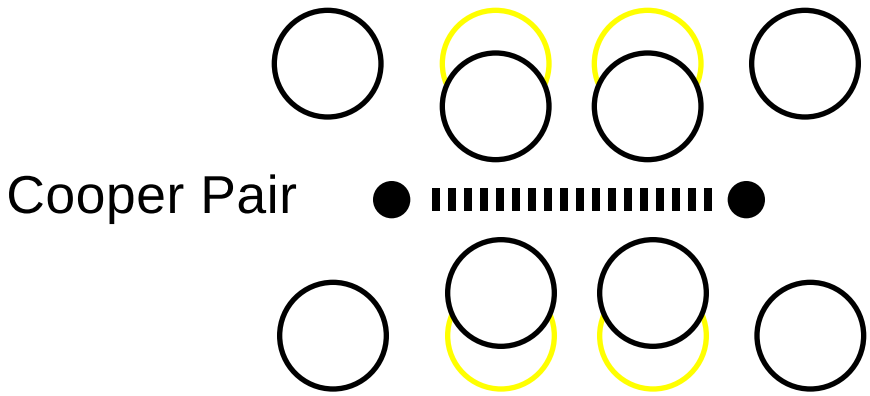
Superconductors



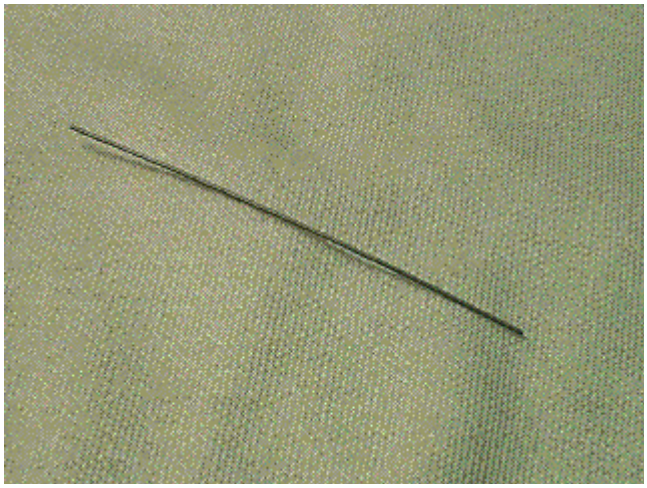
Meissner Effect

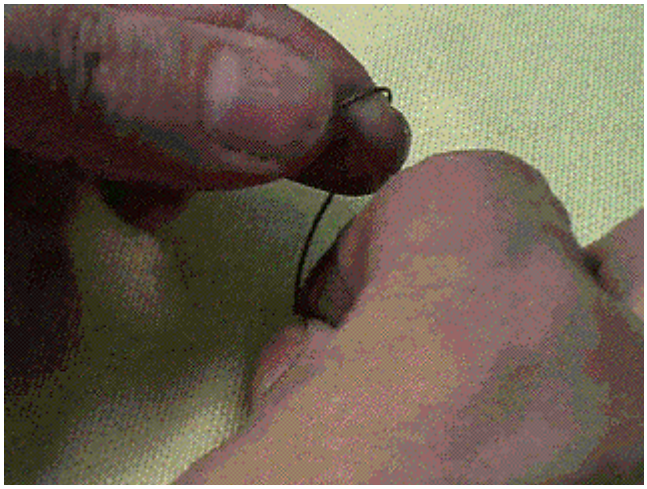


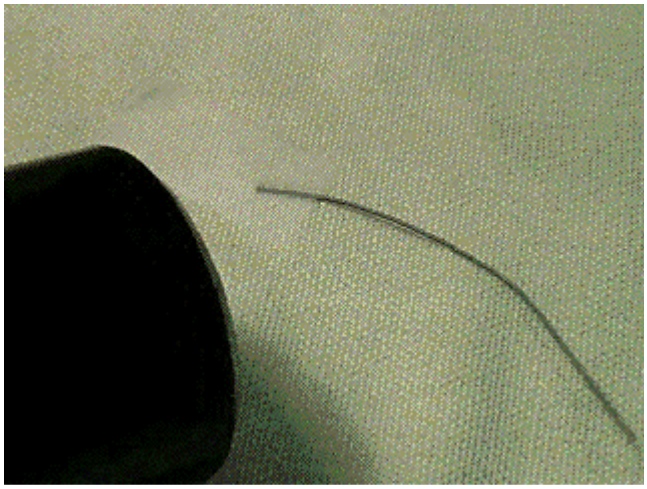




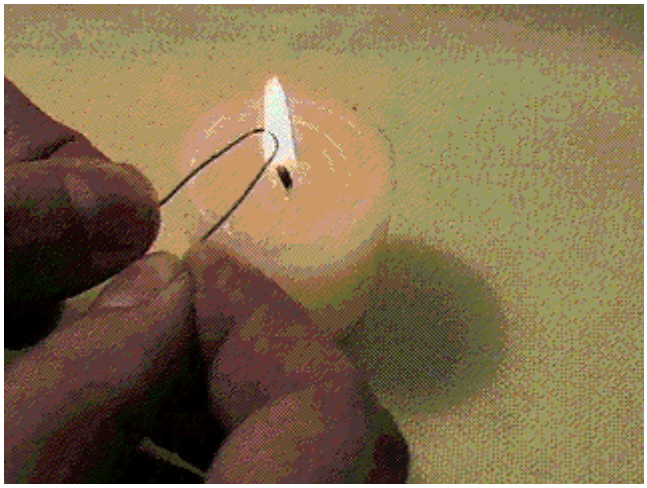
NiTi Solid State Phase Transition

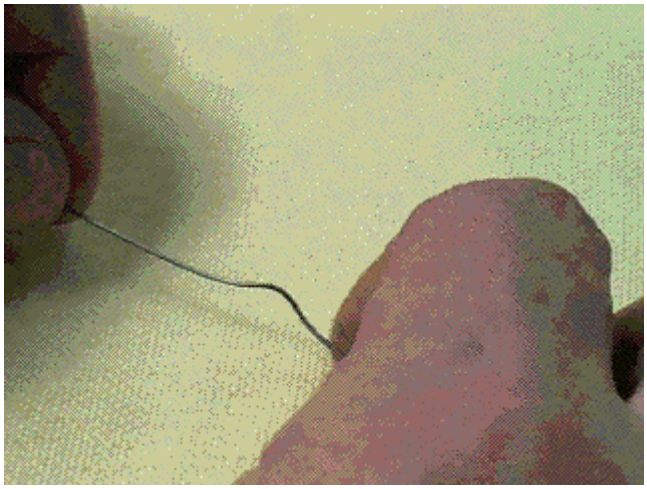


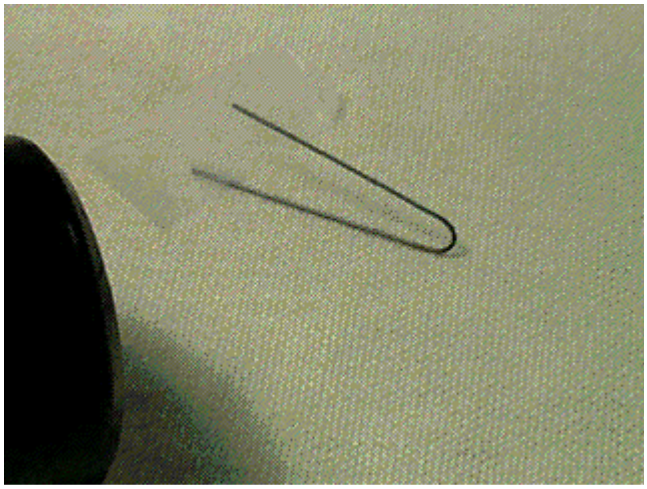




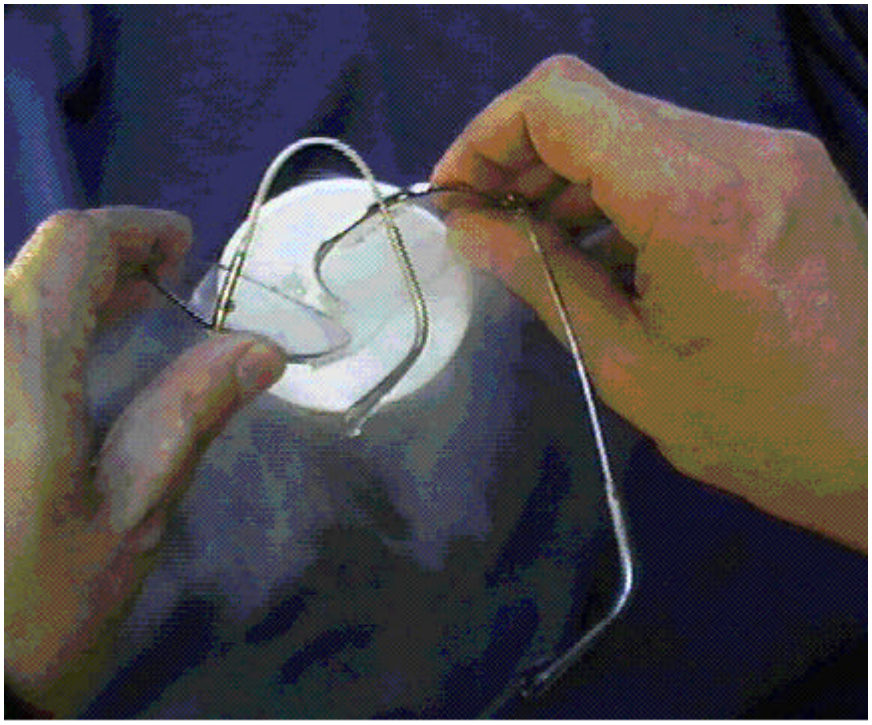
Retraining NiTi Wire



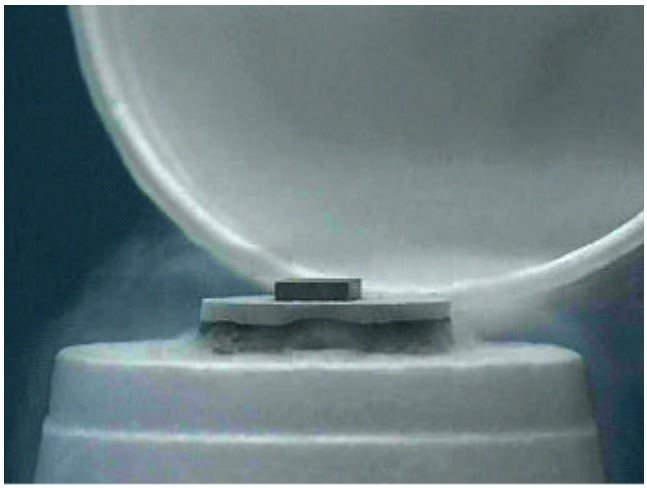


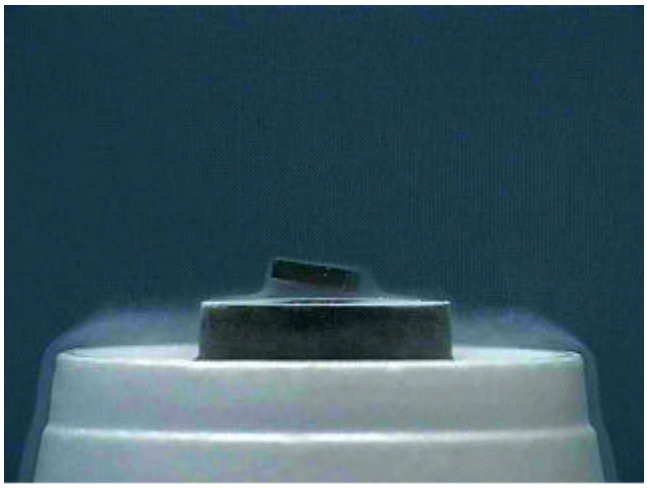


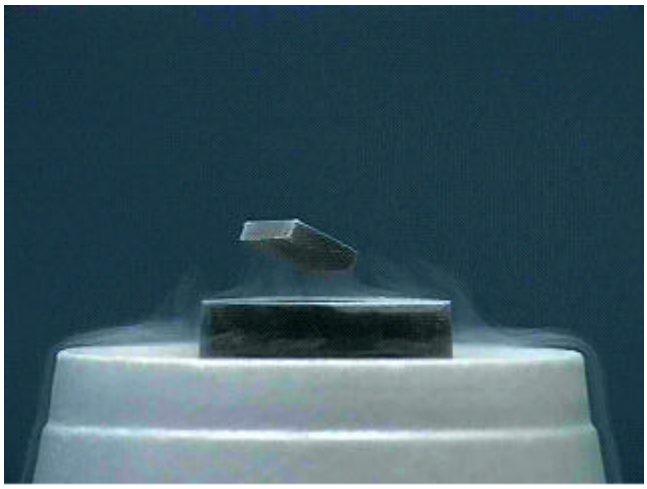
NiTi Eyeglass Frames



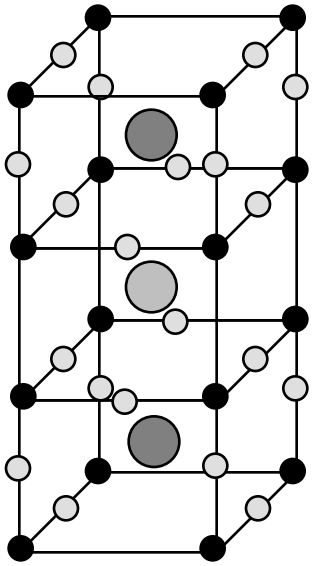
Superconductivity







1-2-3 Superconductor



$YBa_2Cu_3O_7$

- Barium
- Yttrium
- Copper
- Oxygen

“Shake-And-Bake” Synthesis

Grind Y_2O_3, $BaCO_3$, and CuO powders together, until they form a homogeneous mixture.

Heat for 18 hrs. at 910 ^oC.

Press pellets at 20,000 psi.

Heat pellets at 910 ^oC under nitrogen for 4 hrs.

Lower temperature to 520 ^oC and place under a flow of oxygen gas for a day.

Shut off furnace and allow samples to cool to room temperature while maintaining the oxygen flow.