



Dental materials

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Lecture 9

Wrought beta titanium alloy

A titanium–molybdenum alloy known as beta-titanium was introduced in 1979 as a wrought orthodontic wire.

The β -titanium orthodontic wires had an approximate composition (by weight) of 79% titanium, 11% molybdenum, 6% zirconium, and 4% tin.

Mechanical properties

1. It can be shaped easily, and the wires can be soldered and welded.
2. Joints can be made by electrical resistance welding.
3. Under proper welding conditions, minimum distortion of the cold-worked microstructure occurs.
4. lower force magnitudes,
5. a lower elastic modulus,
6. a higher spring back (maximum elastic deflection),
7. a lower yield strength, and good ductility, weldability, and corrosion resistance.
8. Beta-titanium alloy has values of yield strength, modulus of elasticity, and spring back **intermediate** to those of **stainless steel** and **Nitinol**. Its formability and weldability are advantages over Nitinol, and it has a larger working range than stainless steel wires.

DENTAL APPLICATION  **Orthodontic wires.**

Soldering Operation of Wrought alloys:

It is often necessary to construct dental appliances in two or more parts and then join them together by either a (soldering) or (welding) process.

Welding: Two pieces of metal are joined together without adding another metal, the metal pieces are heated to a high enough temperature so they attach to each other.

Soldering/Brazing: Two pieces of metal joined by adding a third metal, if the temperature used in the process is below 425C° the process is called (Soldering), if the temperature is above 425C° called Brazing.

Types of Soldering:

Solders may be divided into two major groups (soft & hard).

1. Soft Solder----Include Lead and tin alloy, the soft solders have several properties including a low fusion range of about 260C or less. Soft solder cannot be used in dentistry due to the lack of corrosion resistance.
2. Hard Solder----- Have much higher melting temperature and greater hardness & strength.

Two types of hard solders are used in dentistry:

1. Gold Solders----used in crown & bridge.
2. Silver Solder----used in orthodontic appliances.

Advantages of Welding Include:

- Produces stronger joints than brazing or soldering
- Produces welded joints that are better suited for high-temperature applications
- Being able to join thin and thick sections of metal (depending on process type)

Disadvantages of Welding Include:

- Producing greater thermal distortion and residual stresses in the joint compared to soldering and brazing
- Requiring a post-processing heat treatment to relieve joint residual stress (depending on application and process)
- Only being able to join similar base materials (for most processes, but not all)

Brazing

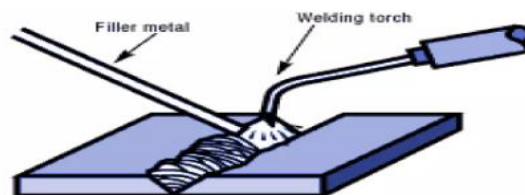
- Brazing is considered a high-temperature version of soldering. There are several brazing variants, including [torch brazing](#), [vacuum brazing](#), [furnace brazing](#), and [induction brazing](#). Regardless of the type, the braze filler metal melts at a temperature above 450°C, but always below that of the base materials to be joined.



Brazing

Some filler metals for brazing

Base Metal(s)	Filler metal(s)
Aluminum	Aluminum and silicon
Nickel-copper alloy	Copper
Copper	Copper and phosphorous
Steel, cast iron	Copper and zinc
Stainless steel	Gold and silver



Advantages of Brazing & Soldering

- Joining dissimilar metals and non-metals.
- Low temperature compared to welding.
- less thermal distortion.
- Less chance of damage
- Speed of joining.
- Less manual skills.



Disadvantages of Brazing & Soldering

- Low strength.
- damaged under high temperature condition.



Brazing Applications

- ▶ Automotive (e.g. Joining tubes and pipes)
- ▶ Electrical equipment (e.g. joining wires and cables)
- ▶ Cutting tools (e.g. brazing cemented carbide inserts to shanks)
- ▶ Jewelry
- ▶ Chemical process industry
- ▶ Plumbing and heating contractors join metal pipes and tubes by brazing
- ▶ Repair and maintenance work



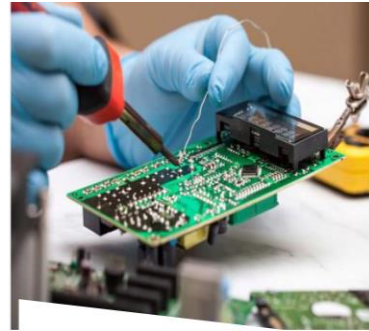
What is Welding?

Welding is an operation whereby two or more parts are united by means of heat or pressure or both. It is usually used on pieces of metal and thermoplastics but can also be used on wood.



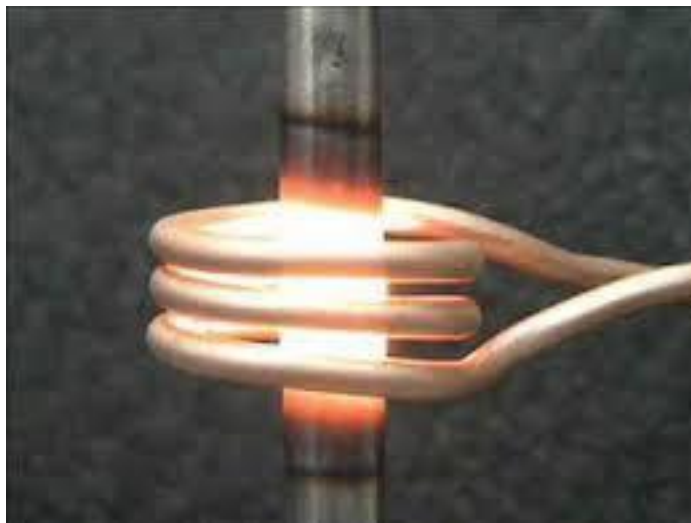
What is Brazing?

Brazing is a joining process traditionally applied to metals (but also to ceramics) in which molten filler metal (the braze alloy) flows into the joint.



What is Soldering?

Soldering is a joining process used to join different types of metals together. Solder is a metal alloy usually made of tin and lead which is melted using a hot iron.



Induction brazing

THANK YOU