# Dental Material

## Physical properties of dental material (thermal properties)

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Lec. 8

# Thermal properties

**Thermal properties** are the response of a material to the application of heat.

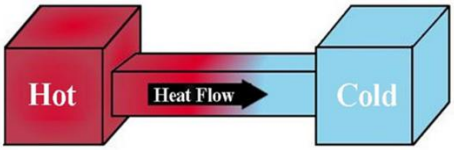
## Thermal conductivity (κ)

Thermal conductivity is the rate at which heat flows through a material over time.

- Materials that have a high thermal conductivity are called **conductors**, whereas materials of low thermal conductivity are called **insulators.**

## Thermal diffusivity

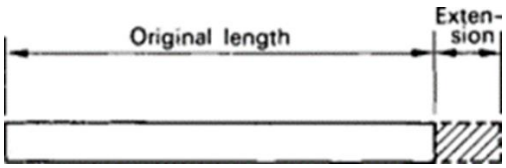
Is the measure of the speed with which a temperature change will spread through an object when one surface is heated.



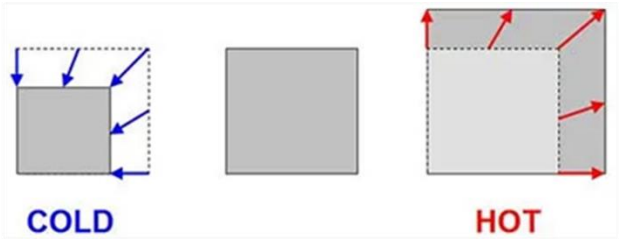

- Thermal diffusivity is the thermal conductivity divided by density and specific heat capacity at constant pressure.
- A material with a high density and high specific heat will have a low thermal diffusivity (temperature changes very slowly through the material).
- A material with low heat capacity and high thermal conductivity lead to high diffusivity (temperature changes rapidly through the material).

## Thermal expansion

**Thermal expansion** is the tendency of matter to change its shape, area, volume, and density in response to a change in temperature.



- Thermal expansion of the material occurs after increasing the temperature is due to increase the kinetic energy of the atoms and increase the vibration which lead to increase the inter atomic spacing, as a result the material expands. After cooling the material contracts.




## Coefficient of thermal expansion (CTE)

It is defined as the change in length per unit of the original length of a material when the temperature of this material is raised 1 °C.

### Measurement of CTE

Several types of coefficients have been developed - volumetric, area, and linear. Which depends on the application.

- **For solids**, it concerned with the change in length, or area.
- **For fluids and gases**, it concerned with the change in volume.
- It is calculated as follows:

$$\alpha = \frac{\Delta L}{L \times \Delta T} \qquad \alpha = \frac{\text{final length (cm) - original length (cm)}}{\text{original length (cm) *temperature change (°C)}} \qquad (cm/cm.^0C)$$

**α** (alpha) is CTE
**L** is original length of material
**ΔL** (delta L) is change in length
**ΔT** (delta T) is change in temperature