

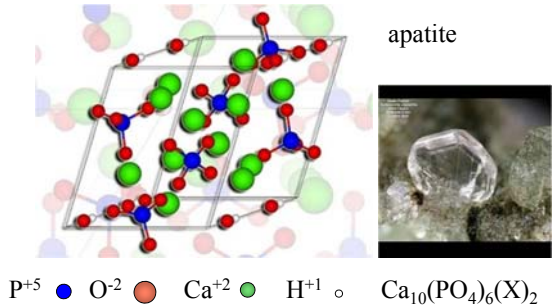
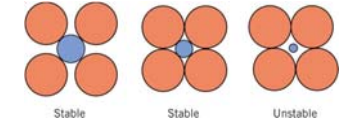
Physical bases of dental material science

Ceramics

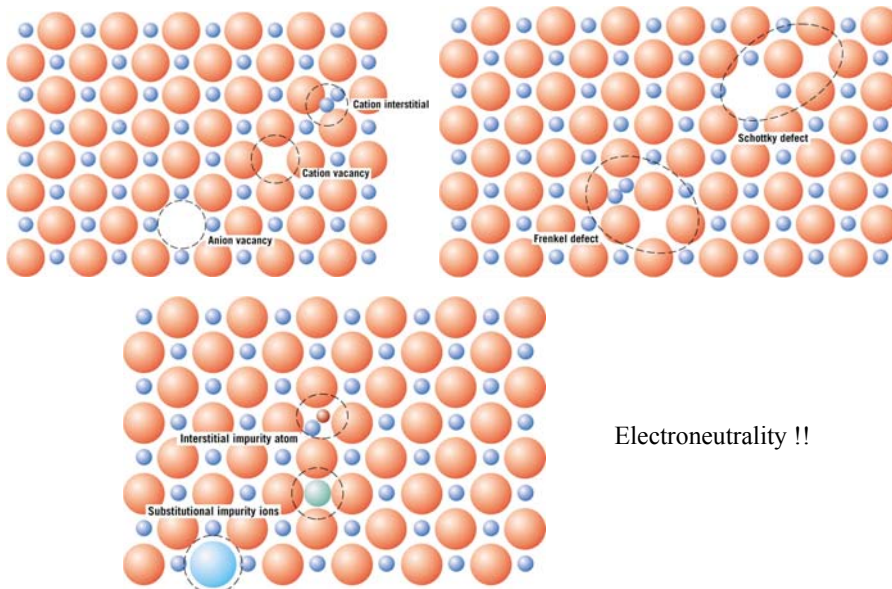
Irén Bárdos-Nagy

Ceramics: compounds of metal and non-metal elements

- mainly ionic bond between the components
- the + ions are smaller
- crystalline or amorphous structure
- phase diagram like in the case of metals



Defects of ceramics

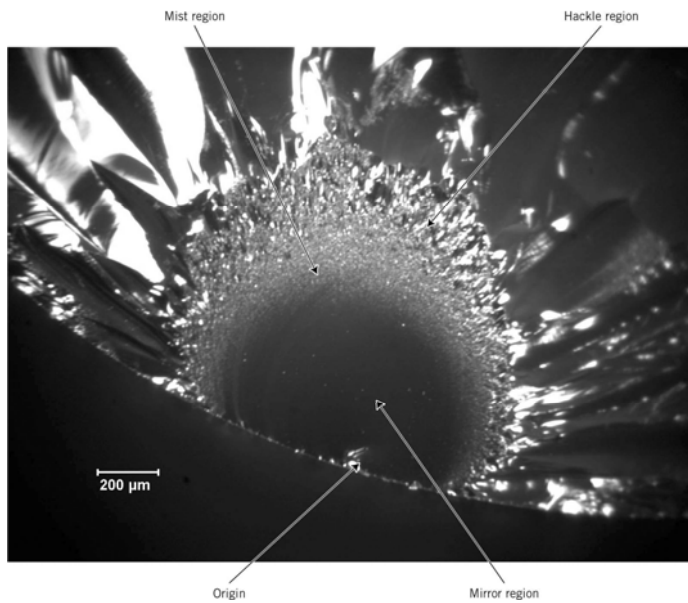


Electroneutrality !!

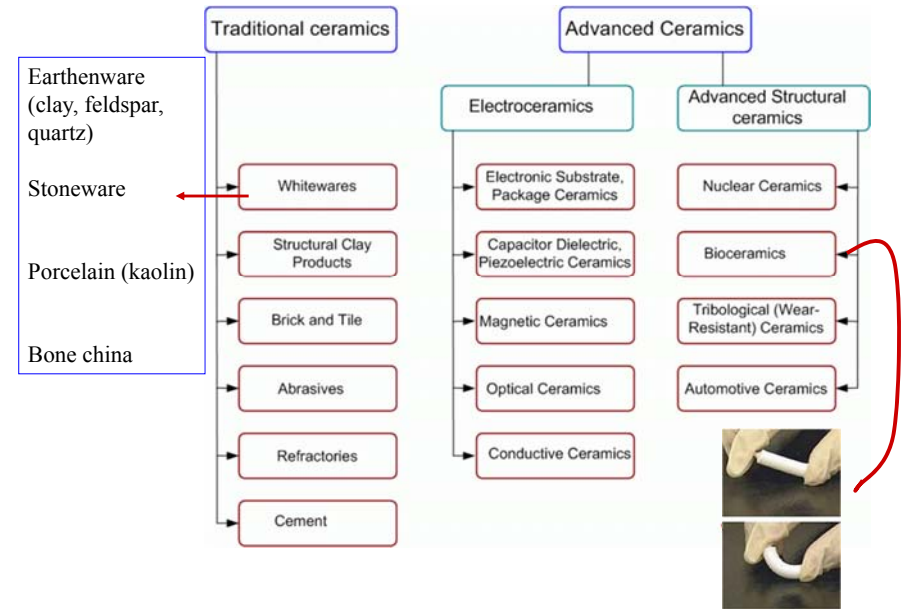
General properties of ceramics

- solid at room temperature
- fragility
- large hardness and rigidity
- strong in compression
- weak in tension and shearing
- poor heat-shock tolerance
- proof against corrosion and heat
- not conduct electric current (insulator)
- biocompatibility





Application base classification of ceramics



Earthenware pottery



Porcelain

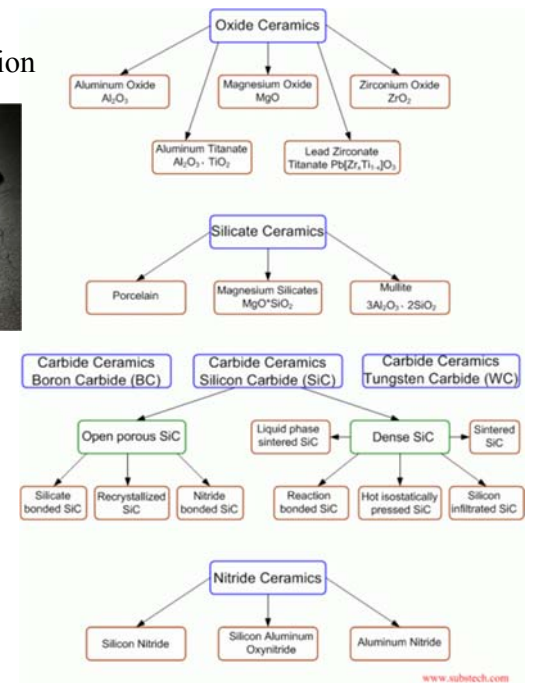
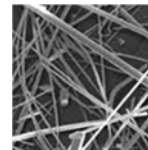


Stoneware vase

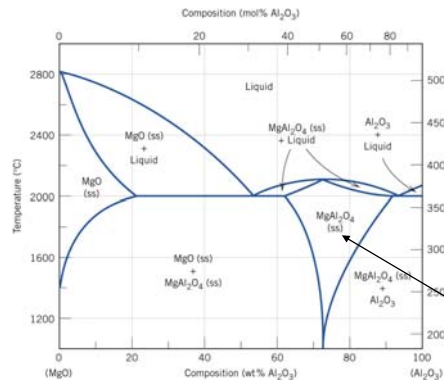
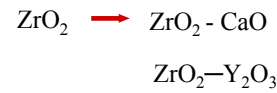


Bone china

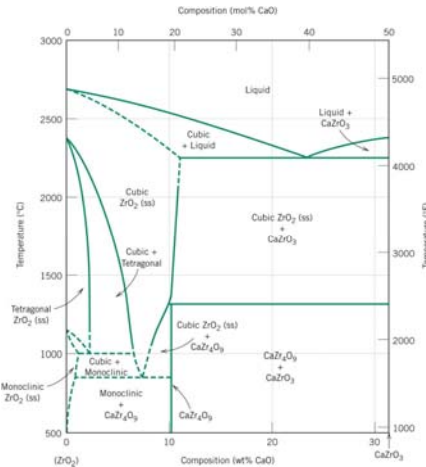
composition base classification of ceramics



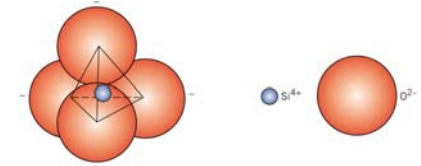
Oxide ceramics



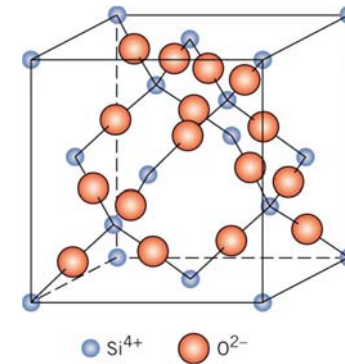
MgO – Al₂O₃
 (MgAl₂O₄ spinel)



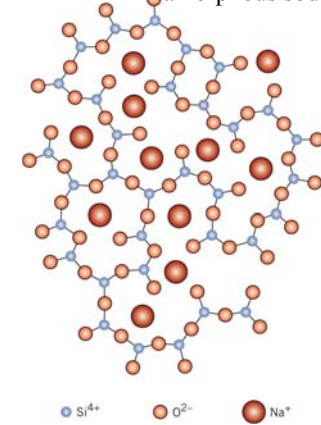
Silicate ceramics



crystal structure of silica

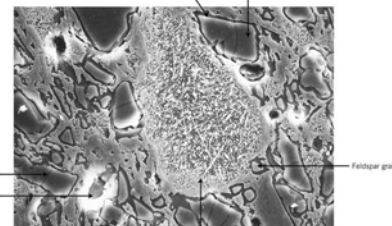
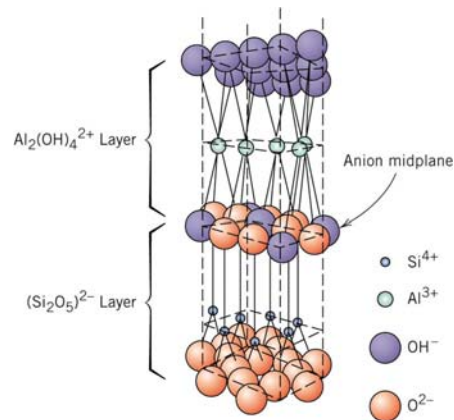


amorphous sodium silicate

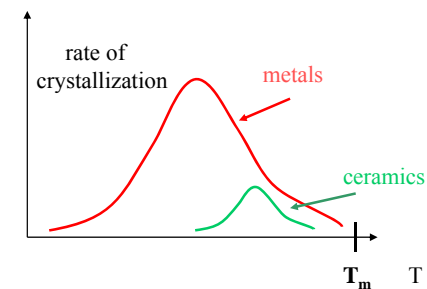
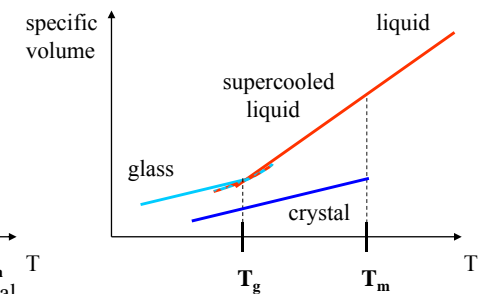
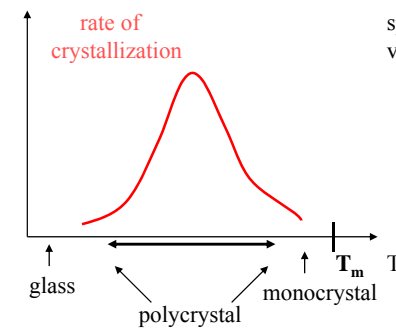


Porcelain

crystal structure of kaolin



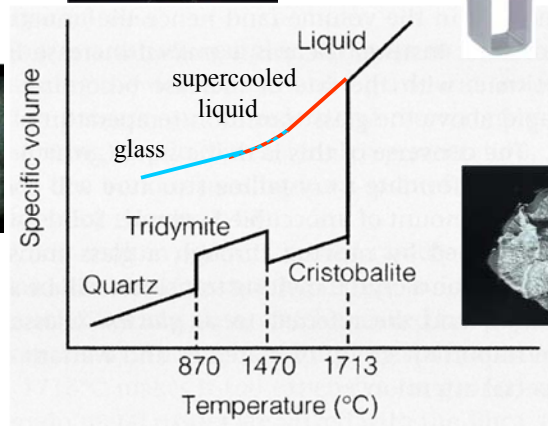
Crystallization ↔ glass formation



SiO₂



silica glass



Glass ceramic share many properties with both glasses and ceramics

glass ceramics structure:

they have amorphous phase
+ crystalline one (controlled crystallization)

main components:

Li₂O – Al₂O₃ – nSiO₂ (LAS-system)

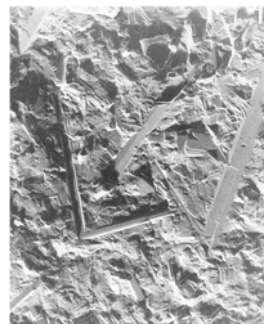
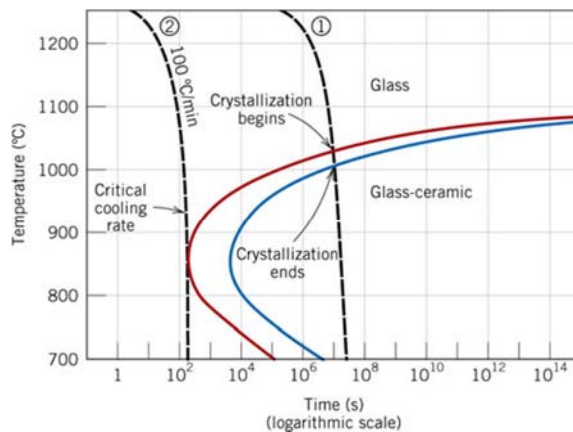
MgO – Al₂O₃ – nSiO₂ (MAS-system)

ZnO – Al₂O₃ – nSiO₂ (ZAS-system)



- properties:
- mechanically strong
 - no pores inside the structure
 - low heat conduction coefficient
 - quick temperature changes (up to 800 -1000 C°)
 - coefficient of thermal expansion can vary with phase ratios (it can be negative or even zero)

Formation of glass ceramics



Dental application of ceramics

- crowns, veneers
- bridges
- fillings
- dental implants
- orthodontic brackets
- cements
- polishing materials

