

Ceramics

A ceramic is any artificially produced object composed by inorganic and non-metallic materials. It is originally very ductile, but rigid and solid after firing.

Ceramic materials have different structures: **crystalline**, **partially crystalline** and **amorphous**. The most common is the crystalline one, that's why by ceramics it is generally meant inorganic crystalline materials.

The word «ceramic» comes from Greek *kéramos*, literally «clay for potter». This material is composed by hydrous aluminum silicates, usually containing potassium, sodium, calcium, magnesium or iron, in small amounts. Its colour may be grey or reddish: it depends on the quantity of iron oxide it contains.

In prehistoric times men used clay to create potters thanks to its properties: it took water up and was easily malleable: those were the earliest ceramics hardened in fire. By and by they made use of moulds, so obtaining several copies of the same original shape. Later they glazed and fired ceramics giving it a coloured, smooth and vitreous aspect. Nowadays ceramics are used in many fields: in housework, in medicine, in electrical and electronics industries, in automotive sector and even in space navigation. This happens in consideration of their special features: they can withstand high temperatures, wear and chemical erosion usually occurring in other materials. Ceramics are biocompatible too, therefore they are instrumental in plants.

Ceramic forming techniques date back to 10.000 years ago, including shaping by hand. The use of the throw spread around 3.000 B.C.: a rotating wheel allowed to create perfectly symmetric objects. Other ceramics forming techniques include tape casting, used for making very thin ceramic condensers, extrusion, used for manufacturing furnace tubes, injection molding, slip casting and so on. Traditionally ceramic materials included clay minerals such as kaolinite, whereas more recent materials include alumina, that is aluminium oxide. Ceramic materials were first moulded in the desired shape, then hardened at high temperatures: this drove water out and allowed strong chemical bonds to form between the flakes of clay.

The modern ceramic materials are classified as advanced ceramics and include silicon carbide and tungsten carbide. Their preparation begins with a fine powder mixed with an organic binder, this helps the powder to consolidate. The result is the so called «green body», the ceramic body before firing. This is first heated at low temperatures to decompose the binder and then at high temperatures and hardened into a strong ceramic.

Glass is not always considered a ceramic because of its amorphous feature; its achievement, however, involves many actions of the ceramic process. Glass, as noncrystalline ceramics, is ordinarily formed by melt, it is shaped when it is fully molten, as a metal, or when it is viscous, blowing to a mold. Finally a «controlled crystallization» and not a spontaneous one, usually not wanted in glass manufacturing, produces the so called glass-ceramics, used to create cooktops.

Activities

True (T) or False (F)?

- T F 1) Ceramic materials are commonly present in nature.
- T F 2) Ceramic generally relate to inorganic crystalline materials.
- T F 3) The red colour is because of iron oxide.
- T F 4) Moulds have never been used in ancient times.
- T F 5) Ceramic materials resist high temperatures.
- T F 6) Ceramics can't withstand chemical erosion.
- T F 7) The «green body» is a ceramic material before heating.
- T F 8) Glass making involves steps of the ceramic process.

Tick the correct answer

1) The first ceramics were:

- a) clay potters.
- b) defensive weapons.
- c) realized for body care.

2) Ceramics glazing:

- a) is not possible because of water clay retains.
- b) gives a vitreous surface.
- c) was an ancient practice.

3) The modern ceramics:

- a) contain binders to consolidate the powders mixed for their preparation.
- b) can't withstand high temperatures.
- c) are more fragile than the prehistoric ones.

Complete the sentences with the correct word

- 1) The prehistoric men used to create potters.
- 2) When men invented the, they could create symmetric objects at last.
- 3) Thanks to their ceramics may be used in plants.
- 4) The «green body» is first fired at to decompose binders used to consolidate it.
- 5) Heating ceramics at high temperatures allows to come out.
- 6) Glass is shaped when it is fully
- 7) Glass crystallization is a process.
- 8) Cooktops are materials.

Keys

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Complete the sentences with the correct word

- 1) The prehistoric men used CLAY to create potters.
- 2) When men invented the THROW, they could create symmetric objects at last.
- 3) Thanks to their BIOCOMPATIBILITY ceramics may be used in plants.
- 4) The «green body» is first fired at LOW TEMPERATURES to decompose binders used to consolidate it.
- 5) Heating ceramics at high temperatures allows WATER to come out.
- 6) Glass is shaped when it is fully MOLTEN
- 7) Glass crystallization is a CONTROLLED process.
- 8) Cooktops are GLASS-CERAMIC materials.