CERAMIC AND COLLOIDAL PROCESSING - EXERCISES - 2021

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Exercises session 1: Solutions

1) What are the typical properties of ceramics and give an example of each property?

- heat resistance (insulation, refractory brick)
- chemical resistance (hip prosthesis, chemical pump)
- high hardness (cutting tool)
- fragility (porcelain cup)

2) Why is shaping by powder processing (powder technology) the main route?

As a consequence of the strong chemical bonds – mainly ionic in oxides and mainly covalent in non-oxides - ceramics have very high melting points (> 1000 ° C) and therefore it is not possible to melt and cast like metals and polymers. This requires shaping via powders to form a green body (powder compact) followed by the so-called consolidation step - sintering.

3) What are the two main categories of raw materials (ceramic powders)?

- synthetic powders (alumina, silicon carbide, etc.)
- natural powders for traditional ceramics (clays, feldspar, quartz, etc.)

4) What is the biggest difference between these two categories of raw materials?

Purity and consequently the prices
Traditional are much less expensive. Close to 1 CHF per kg compared to 100 CHF per kg.

5) What are the general properties of a powder for the manufacture of ceramics?

- known chemical purity,
- good reactivity, size ~ 1 μm and specific surface ~ 5-15 m^2/g and
-good homogeneity - physical and chemical.

6) Discuss the impact of ceramics in everyday life for the general public.

Ceramics are widely used in various fields (dental prostheses, engine valves, electrical capacitors….).

You can almost say that wherever there are temperature variations, there are ceramics, because they expand very little unlike metals and are more resistant to heat and deformation than polymers.
However, their main drawback is their fragility.
We find ceramics in the form of small parts (dental prosthesis) or large sizes (wash basins). Their electrical resistance and their resistance to heat make them important elements in the electrical and electronic fields. There are over 700 ceramic capacitors in a typical mobile phone. Besides these technical aspects, often hidden from the public eye, ceramics are essential in the field of tableware, sanitary ware and tiling. We can also add to the utilitarian side of ceramics an artistic aspect, especially with regard to traditional ceramics.