Question

Differentiate between ceramics and nano ceramics materials?

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Ceramic

Ceramic materials

Definition

- a ceramic is an inorganic non-metallic solid madeup of clay that have been shaped and then hardened by heating to high temperature.

Nanoceramic materials

- Nanoceramics are like super tiny, super special ceramics. Imagine making ceramics like pots or tiles but really small like too small to see with your eyes. These are supertiny ceramics are superstrong work well in tiny electronic gadgets and even help in medicine

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Examples

- Tile
- Bricks
- Pottery
- Porcelain
- Nanoparticles (silica, zinc oxide)

Properties

i) **Considerable stiffness**
They are stiff under compression and bending

ii) **Corrosion / oxidation resistant**

iii) **Brittle, having little elasticity**

iv) **Thermal and electrical insulator** but certain ceramics conduct electricity.

i) **Increased surface area** which boosts reactivity and allows for **tailored structures**. This leads to improved mechanical strength, thermal and electrical conductivity

ii) **Reduced grain boundaries** Enhance performance, crucial in applications like cutting tools and electronics.

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v) **wear-resistant and durable,** therefore are used in industry

iii) **Biomedicine**

In Biomedicine, nanoceramics offer superior biocompatibility, ideal for implants and drug delivery.

Applications

1) **Aerospace**

It is used in the formation of parts of space shuttle, rockets and space stations

2) **Consumer usage**

It has great use in homes like glassware, pottery etc

3) **Automative Industry**

It is used in catalytic converters, filters, plugs, thermostats etc

1) **Armor**

Nanoceramics can be used in body armor to absorb K·E from blunt trauma and high velocity ammunition.

2) **Bone tissue engineering**

It helps to

Compare side by side

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4) **Medical (Bioceramics)**
Ceramics are used in medical field especially in dental and bone fillings and in bone implants.

5) **Buildings and construction**
Manufacturers use ceramics to make bricks, tiles, piping and other construction materials.

to support bone regrowth and repair.

3) **Electronics**
Nanoceramics can be used as insulators, semiconductors, condutors and magnets.

Production

1) Raw materials
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2) Mixture and Homogeneization
↓
3) Wet milling — Particle size <200 nm
↓
4) Atomization — wet degree 5.5-7%.
↓
5) ~~Shaping~~ — Hydraulic Press 40MPa
↓
6) Drying — Wet degree 0.2-0.5%.

1) Material selection
- staring material (metal oxides)
- select solvent. (water, ethanol)

↓

2) Synthesis
- Sol-gel Processing
- Hydro thermal synthesis

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7) glazing layer thickness 75-500um

8) Fast firing 40-50min

9) Ceramic Tile

3) Powder processing
- Draw the gel or powder
- crush and grind into a fine powder
- sieve to remove agglomerates

4) Compaction
- Uniaxial pressing
- Isostatic pressing

5) Sintering
- Heat the compacted powder
- Hold for a time
- Cool slowly

6) Characterization
- Measure grain size and distribution
- Determine surface area
- Test strength and hardness

7) Final processing
- machining or grinding to desired shape
- surface treatment (coating, polish)