NANOSTRUCTURED CERAMIC COMPOSITE MATERIAL WITH REGULATED POROSITY

Description
A new technology for production of high strength and high tough nanostructured nanopowder-based metallic and ceramic materials is developed. The materials have high activity under sintering. We developed methods of ceramics synthesis from nanopowders which pore space volume is from 10 to 60% and pore size from 1 to 1000 μm. Spalling-resistant ceramics is obtained, having density up to 98% from theoretical under high distribution of strengthening phase.

Specifications
Comparison of main economic parameters of structural ceramics on ZrO₂ base with best analogs

<table>
<thead>
<tr>
<th>Main operation parameters</th>
<th>Syntec-Ceramics (Germany)</th>
<th>Toshiba (Japan)</th>
<th>Kyocera Technical Ceramics (Japan)</th>
<th>ISPMS SB RAS (Tomsk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength of flexure, MPa</td>
<td>650</td>
<td>800–1100</td>
<td>980–1960</td>
<td>800–1600</td>
</tr>
<tr>
<td>Toughness MPa·m^{1/2}</td>
<td>8.8</td>
<td>8–10</td>
<td>4–5</td>
<td>12–18</td>
</tr>
<tr>
<td>Density, g/sm³</td>
<td>5.7</td>
<td>6.0</td>
<td>5.5–6.05</td>
<td>5.8–6.0</td>
</tr>
</tbody>
</table>

Samples of tough structural ceramics.

Nanostructured ceramics.
Average size of crystallites is 16 μm.

Technical appraisal and economic benefits
Nanoceramic materials on ZrO₂-base provide unique complex of mechano-physical features:
- Due to special technology of synthesis ceramics has high values of strength, toughness and wear-resistant.
- High operation features in high temperature (above 1600 °C) and corrosion active conditions without decreasing mechanical features.
- Capacity of absorbing and containing in pore space amount of active liquids.

Application areas
Structural ceramics is applied for manufacturing the following products: cutting edges and draw plates for plastic treatment and wire broaching, chemical fiber cutting, blades of scissors and medical scalpels, spray chamber jets, tightening, connecting pipes, impellers, etc.

Porous ceramic materials can be applied for making cages for fuel cells, active elements for micro motors for aircrafts control, for porous reservoirs for chemical wastes processing, for filters, catalisator carriers, etc.

Development stage
On the base of the developed technology for electroconductive porous ceramic it is developed and jointly tested with industrial merger “Polet” micromotors active elements for space aircraft control.
Porous ceramic cages are effective for developing advanced fuel cells which are currently developed by world leading industrial companies.

It is synthesized spalling-resistant permeable metal-ceramics with a porous ceramic matrix from nanocrystal powder ZrO$_2$(Y$_2$O$_3$) reinforced by polycrystal fibers.

It is developed experimental-industrial technology for making products of complicated shape from structural and functional nanoceramics by method of thermoplastic slurry casting and soft powders pressing.

To promote presented above development ISPMS SB RAS actively cooperate with such Russian companies as Federal State Unitarian Enterprise “Siberian Chemical Complex” Rosoboronexport”, industrial merger “Polet” (Omsk city) and others.

Technologic equipment for HTS of ceramics

“Ceramics ZrO$_2$ (porous matrix)- NiTi (fiber)” composite material

Nowadays it is launched large-capacity production of plasmachemical powders on ZrO$_2$-base which provide realization up to several tons of material per year.

According to the marketing investigation results of demand on ceramic products it is received orders and queries on nanoceramic product supply from more than 100 customers in Russia and CIS.

Patent situation


Commercial offers

Technology transfer on base of license agreement.

Supply of ceramic composite material.

Development of spalling-resistance and penetrable nanoceramics according to Customer’s specification

Training for Masters and postgraduate students in the sphere of methods of contemporary ceramic material synthesis.

Estimated cost

Contractual price.

Contacts

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