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MULTIDIMENSIONAL PERSPECTIVES OF INDUSTRIAL CERAMICS AND ALLIED ASPECTS

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Abstract
Ceramics are broadly defined as inorganic, nonmetallic materials that exhibit such useful properties as high strength and hardness, high melting temperatures, chemical inertness, and low thermal and electrical conductivity but that also display brittleness and sensitivity to flaws. As practical materials, they have a history almost as old as the human race. Traditional ceramic products, made from common, naturally occurring minerals such as clay and sand, have long been the object of the potter, the brickmaker, and the glazier. Modern advanced ceramics, on the other hand, are often produced under exacting conditions in the laboratory and call into play the skills of the chemist, the physicist, and the engineer. Containing a variety of ingredients and manipulated by a variety of processing techniques, ceramics are made into a wide range of industrial products, from common floor tile to nuclear fuel pellets. Yet all these disparate products owe their utility to a set of properties that are universally recognized as ceramic-like, and these properties in turn owe their existence to chemical bonds and atomic structures that are peculiar to the material. The composition, structure, and properties of industrial ceramics, their processing into both traditional and advanced materials, and the products made from those materials are the subject of many articles on particular traditional or advanced ceramic products, such as whitewares, abrasives, conductive ceramics, and bioceramics. For a more comprehensive understanding of the subject, however, the reader is advised to begin with the central article, on the composition, structure, and properties of ceramic materials.

Keywords: Ceramics, Conductive Ceramics, Industrial Ceramics, Applications of Ceramics

Introduction
The mention of the word ceramic takes you to the world of earthenware, clay pots etc. found in many households. Treasured by both the owner and the maker, these products are made from naturally occurring clay and sand. With the advancement of technology, ceramic materials are now being manufactured in a laboratory under the watchful eye of a scientist. Made with a variety of ingredients and a number of processing techniques, ceramics are made into a wide range of industrial products.

Ceramics made through the above mentioned process are known as advanced ceramics or industrial ceramics. Their thermal stability, wear-resistance and resistance to corrosion of ceramic components make the application of ceramics the ideal choice for many industrial uses.

Alumina Ceramic
Alumina is one of the most widely used advanced ceramic, and is made from aluminum oxide. This ceramic can be made via different types of manufacturing processes including isotactic pressing, injection molding and extrusion. Finishing can be accomplished by precision grinding and lapping, laser machining and a variety of other processes.

Alumina's high ionic inter-atomic bond makes it chemically very stable, thereby making it a

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good electrical insulator. Further it is extremely resistant to wear and corrosion and has a high mechanical strength. Due to all these qualities, alumina components are used in semiconductor components, pump components, electrical insulations and automotive sensors.

Steatite Ceramic
This advanced ceramic is made from magnesium silicate and is a popular choice of material for insulators for electrical components. Other properties of steatite include excellent dielectric strength, low dissipation factor, and high mechanical strength. Further, due to Steatite's excellent insulating properties it is used in thermostats and many other electrical household products.

Zirconia Ceramic
Made from zirconium oxide, this ceramic has excellent strength and a high resistance to corrosion, wear and abrasion. Since it has a high tolerance to degradation, zirconia is the material of choice in the manufacturing of bearings and grinding. Further due to its high resistance to developing cracks, commonly referred to as 'fracture toughness', zirconiais used in structured ceramics, automotive oxygen sensors and dental ceramics.

Silicon Carbide Ceramic
When the grains of silicon carbide are bonded together through a process called sintering, they form a very hard ceramic. Due to its hardness, it is used in applications requiring high endurance such as car brakes, car clutches, ceramic plates and bullet proof vests.

Cordierite Ceramic
Cordierite typically occurs in contact of argillaceous rocks. Cordierite has a very high thermal shock resistance and thus widely used in high temperature industrial applications such as heat exchangers for gas turbine.

Mullite Ceramic
Mullite is a very rare silicate material, formed at high temperatures and low pressure conditions. Its properties include low thermal expansion, low thermal conductivity, excellent creep resistance, suitable high temperature strength and outstanding stability under harsh chemical environments. It is commonly used in thermocouple protection tubes, furnace muffles and kiln rollers.

Industries Served
The above industrial ceramics materials have applications in the automotive, healthcare, defense, marine, aerospace and telecommunication industry.
Usually, Ceramic products are divided into 4 sectors

- Structural, pipes, including bricks, roof tiles & floor
- Refractory, such as kiln linings, gas fire radiant, steel and glass making crucibles
- White wares, sanitary ware, including tableware, pottery products and wall tiles
- Technical, is also known as Engineering, Advanced, Special, and Fine Ceramics. Those items include tiles used in the Space Shuttle program, ballistic protection, nuclear fuel uranium oxide pellets, gas burner nozzles, bio-medical implants, missile nose cones, and jet engine turbine blades. Repeatedly the raw materials do not include clays.

Industrial ceramic Products
Assorted organizations are offering the following industrial ceramics products based on the industry.

- Engineered Ceramics
- Metallized Ceramics
- Wear Resistant liner
- Ballistic Protection
- Lined equipment
- Grinding Media

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Industrial ceramics Industry

- Ceramic Tiles
- Cement
- Power Generation
- Steel Industry
- Fluid Handling
- Power Distribution Equipment
- Coal Washery
- Armour

Conclusion

The bonding of atoms together is much stronger in covalent and ionic bonding than in metallic. That is why, generally speaking, metals are ductile and ceramics are brittle. Due to ceramic materials wide range of properties, they are used for a multitude of applications. housands of engineering gears have used from advanced ceramics solutions for wear resistance, corrosion resistance & thermal resistance, providing significant lifetime added to over conventional metal gears. It is not always the best possible design solution, commonly advanced ceramics can be benefited as direct substitutes for available designs. Typical gears include wear plates & thermal barriers, bearings for high speed and high stiffness spindles, bushes, gears and many others. Dynamic-Ceramic can provide now hundreds of case histories on the successful and cost effective application of advanced ceramics solutions in mechanical engineering applications. Although ceramics have been used by man for many centuries, until recently their applications have been limited by their mechanical properties. Unlike metals, most ceramics materials do not exhibit a non-linear plastic region before failure. Instead, ceramics are known to be brittle and fail catastrophically. Their application in engineering applications has certainly been limited by their lack of toughness.

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