THE PLACE OF CERAMIC MATERIAL IN TECHNOLOGICAL DEVELOPMENT

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Abstract
Ceramics is an area that is used in human endeavours due to the special qualities of the material that is usually involved. The materials are seen as the centre of technological development, because of the impact made in diverse fields. For instance, in electronic and electrical industries, advanced ceramics materials like Barium (Batio3) Piezoelectric and semiconductor materials are utilized for producing ceramic capacitor vibrators, temperature sensors. It is observed that about 302-90% of our homes have organic products like. Electricity, telecommunications, the paper works of the place and the ceramics materials.

Key Words: Materials, Ceramics, Processing Technology, Development

Introduction

Alkali (2009) posits that ceramics is an area that is useful in vital areas of human endeavour, due to the special qualities of the material (clay), which is usually involved. It is through the manipulation and firing of clay items that we can achieve ceramics of divergent nature which includes tableware, sanitary wares, conceptual and high-tech equipment with a high level of intellectual content. Ceramics is the science and technology of creating objects from inorganic and non-metallic materials by the action of heat at lower temperatures using precipitation reactions from high purity chemical solutions and the purification of raw materials. Giudice and Canosa (2017) opined that materials are at the centre of technological advancement. This is as evident as the progress that has been made in fields as diverse as engineering medicine, biology, among other fields. Ceramics is observed by Otimegu (2015) as the technology of transforming, clay products and shapes by subjecting them to high temperatures. This is also asserted by the American Ceramics Society (2014). It is an organic non-metallic material that is typically crystalline in nature.

Eze and Ugochukwu (2014) are of the view that ceramic is an aspect of art that brings the reality of art to the sense of perception, as a means of the expressive process of self-discovery and a personal exploration that can lead to technological development through materials and techniques utilized.

It is observed that ceramic materials may have a crystalline or partly crystalline structure with the long-range order on the atomic scale. The quality of ceramics materials gives rise to many applications in material engineering, electrical engineering, chemical engineering and mechanical engineering. Ceramics are heat resistant, as such, they can be utilized for many things, for which materials like metal and polymers are unsuitable. Ceramics materials are used in a wide range of industries including mining, aerospace, medicine, refinery, food chemical industries, packaging, science, electronics, and industrial transmission, electricity and guided lightwave transmission. This paper levels on the place of ceramic materials in technological development.

Ceramics Material Groups

It is stated by CeramTech (2014) that ceramic materials make applications possible today, which was visually inconceivable before. This is attributed to their unique material properties. CeramTech noted that, basically ceramic materials can be divided into four major groups; silicate ceramics, oxide ceramics, non-oxide ceramics and piezoceramics. Silicate ceramics are said to be the oldest type of ceramic materials for traditional applications and are made primarily from natural raw materials in conjunction with (aluminium oxide, aluminium silicate).

The oxide ceramics contains materials that consist of metal oxide such as (aluminium oxide, aluminium titanate). The Non-oxide ceramic material is comprised of materials based on Carbon, Nitrogen and Silicon compound such as (Silicon carbide, Silicon nitrate and aluminium nitrate). Piezoceramics material is used to convert mechanical parameters or convert electrical signals into mechanical movement or vibration.

Ceramic Materials and Their Uses

Ceramic materials are considered as being special because of their properties. They possess high melting points, low electrical and thermal conductivity value and high comprehensive strengths. They are generally hard and brittle with a good chemical and thermal stability. Jayakody (2009) stated that ceramics materials can be categorized as traditional and advanced.

Ceramics materials consist of Silica and Feldspar. Usually, they don't meet rigid specific properties after their production, as such; cheap technologies are utilized for most of the production processes.

Traditional ceramics: Ball clay, China-clay, Feldspar, Silica, Dolomite, Tale, Calcite and Nepheline are among the common materials used for most ceramic products. Each of these raw materials contains a certain property, such as dry strength, plasticity, shrinkage etc. to the ceramic body. The traditional ceramic industries today are many. Examples of the products of traditional ceramics are pottery, tableware, sanitary ware, tiles, structural clay products, refractories, blocks, and electrical porcelain. Ofimeyin (2015) sees the development brought about by ceramic materials. The advanced ceramics are seen as special and used mainly for electrical, electronic optical and magnetic applications. This differs from traditional ceramics due to the fact that ceramic powder preparation is important. Advanced production techniques are utilized to ensure that produced ceramic powders possess sufficient purity.

In electronic and electrical industries, advanced ceramic materials like Barium (BaT103), piezoelectric materials and semiconductor materials are heavily utilized for producing ceramic capacitors, vibrators, temperature sensors, oscillators e.t.c. (termed as functional ceramics). Otome noted that, about eighty to ninety percent of our homes are made of ceramic products. This ranges between cerement, steel, electronics, electricity, telecommunications or space travel among others. Specific properties of advanced ceramic materials are used for their industrial applications. Ferroelectricity is such proper material like Lead Zirconate Titanate, Lead Titanate, Barium Titanate. Other applications that are found in other areas include magnetics ceramics-a type of advanced ceramic material that is used for the production of antennas and inductors. Bioceramics like Alumina with high density and purity is used for dental implants; Eyeglasses, chemical ware and the replacement of hips and knees e.t.c are some of the application of bioceramics materials. Traditional ceramic materials that have been in use in ancient civilization, is still of significant importance for the industry today.

It is observed by Akiyoshi, m, Tsuchida, H, and Yamo. T, that, several structural ceramic materials possess many superior properties for nuclear applications such as blanket of a future fusion reactor, or core material of high-temperature gas cooling fusion reactor for hydrogen generation, where they would be exposed to the high influence of neutrons of temperatures up to 1400K.

Trinkler, L and Berzina B (2017) posit that Aluminum nitrate (AIN) is a band material with a wurtzite structure. It is applied in microelectronics as substrate, insulator and packaging material; due to the combination of the uppermost qualities, such as high thermal conductivity, good dielectric properties and thermal expansions coefficient comparable with that of silicon.

Available literature in the field of ceramics materials shows that the military requirements of World War II are said to have encouraged developments, which created a need for high-performance materials and helped speed the development of ceramic science and engineering. Between the 1960s and 1970s, new types of ceramics were developed in response to advances in atomic energy, electronics, communications and space travel. The discovery of ceramic superconductors in 1986 spurred up intense research to develop superconducting ceramic parts for electronic devices, electronic motors, and transportation equipment.

Conclusion

Research ceramic has established that it is an important field of science. Applications continue to expand as researchers develop new kinds of ceramics to serve different purposes. For instance, Zirconium dioxide is utilized in the manufacture of knives. The blade of ceramic knife stays sharp far much longer than that of the steel knife. Ceramic such as alumina, boron carbide and silicon carbide have been utilized in bulletproof vest to repel small rifle fire.

The 1980s witnessed Toyota's released production of an adiabatic ceramic engine that can run at a temperature of over 6000 of (3300oc). Ceramic engines do not require a cooling system,

allow major weight reduction and give greater fuel efficiency. Currently, an effort is being made to develop ceramic parts for gas turbine engines. Glass ceramic materials share many properties with both glass and ceramic. Glass ceramic has an amorphous phase, one or more crystalline phases and is reproduced by controlled crystallization.

References

Alkali, C.V. (2009) The Evolution of the Practice of Non-Pot Ceramic in Nigeria: Merits Demerits. In *Ashakwu, Journal of Ceramics* Vol .6, Pp19-20.