

From Bio-Implants to Smart Glasses

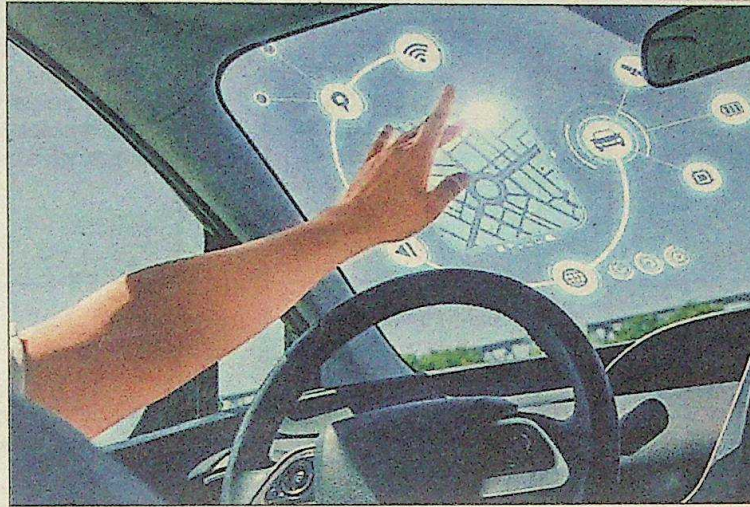
Careers in the Ceramic & Glass Technology

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Ceramics and glass are no longer just the material for your windows and flooring! Ceramic and glass technology has advanced significantly and it is everywhere around us; from the smartphone you are probably looking at right now to the aeroplanes flying in the sky. Beyond the artistic and cultural aspects, ceramics and glass have found crucial applications in today's industries, playing vital roles in areas like electronics, energy, healthcare and even space exploration.

Thus, there is a growing demand for professionals who understand the intricacies of ceramics and glass technology. Industries are actively seeking individuals with expertise in these areas, whether it is designing cutting-edge materials, optimising manufacturing processes, or ensuring the reliability of components in high-tech applications.

So, if you have an interest in materials science, engineering or technology, exploring a career in



ceramics and glass could open up a world of opportunities in fields that are shaping the future of technology and industry. Whether you're drawn to research and development, quality control or design, there's a wide range of exciting possibilities to explore!

Unique Characteristics and Market Dynamics

The ceramic and glass industry boasts versatility in its applications, meeting the demands of diverse sectors.

increasing global emphasis on sustainability, the ceramic and glass industry has become a key player in eco-friendly solutions. These materials are inherently more environmentally friendly than alternatives and manufacturers adopting sustainable practices gain a competitive advantage.

The ability of the ceramic and glass industry to produce customised and speciality products further enhances its revenue and employment generation potential. From bespoke architectural glass to high-performance ceramics in aerospace, these niche markets offer premium pricing opportunities. Companies that excel in delivering tailored solutions often command higher profit margins, contributing to an overall increase in earnings.

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EN QUESTION OF THE WEEK

Readers' views elicited on important issues

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From Bio-Implants to Smart Glasses ...

The ceramic and glass industry is closely tied to infrastructure development, including construction projects and transportation systems. As emerging economies continue to invest in urbanisation and industrialisation, the demand for ceramic and glass products is set to rise.

The interconnected nature of the global economy has led to increased supply chain integration. The ceramic and glass industry, with its extensive network of raw material suppliers, manufacturers and distributors, has leveraged this integration for efficient operations and cost-effective production.

Key Sectors

Ceramics, originating from the Greek word 'keramikos' meaning 'of pottery,' are inorganic materials shaped and hardened at high temperatures. Technological advancements led to improved ceramic production methods, expanding beyond clay-based materials. Advanced ceramics' versatile applications extend to electrical, electronic, optical and magnetic industries, driven by their highly desirable properties essential for technological advancements.

Automotive industry: Brake disks, cylinder sleeves and heat shields in cars are commonly made from silicon carbide ceramic matrix composites.

Aerospace: The high mechanical strength and thermal resistance of CMCs enable their use in turbine engines of spacecraft and inside combustion chambers.

Semiconductors: Ceramics are widely used in the production of semiconductor components. They provide excellent thermal and electrical insulation properties, making them ideal for use in electronic devices.

Augmented Reality: Smart glasses have transformed our interaction with digital information, seamlessly blending the virtual and physical worlds through transparent displays made of glass. These glasses utilise transparent glass waveguides to direct light, creating an illusion of seamlessly integrated digital information in the user's surroundings.

Electronics: Due to their low dielectric constant and low thermal expansion, glass ceramics are used in microelectronics as substrates and insulating layers.

Civil Engineering: For centuries, ceramics have found an essential place in the domain of civil engineering. From common applications like building bricks and tiles to advanced utilisation in cutting-edge materials like geopolymers, the use of ceramics in civil engineering is diverse and extensive. Geopolymers are a type of inorganic polymer concrete, made from industrial waste, that demonstrate exceptionally high chemical and heat resistance and they represent an eco-friendly alter-

native to traditional portland cement. Certain ceramics are also used in road construction due to their resistance to wear and tear.

Bio-engineering: Biocompatible ceramics are used in medical implants, such as dental crowns and bone replacements. These materials ensure compatibility with the human body and provide longevity and stability to the implants.

Digital Devices: Ceramic materials are used in the manufacturing of hard drives, where they provide a smooth and durable surface for the storage disks. This helps in maintaining the integrity of data stored in digital formats. Glass is also utilised in the development of storage media like optical discs. This technology is still relevant for archival purposes and advancements continue to be made in this area.

Solar Panels: Ceramic technology is employed in the production of coatings for solar panels, enhancing their efficiency by allowing maximum light transmission while providing durability.

Interior Designing: In modern construction, ceramic is a key material for facades and interior design. Smart ceramic technology contributes to energy efficiency in buildings. Digital printing technology has enabled intricate designs on ceramic tiles.

Latest Trends

Advanced Manufacturing Techniques: The ceramic and glass industry has been increasingly adopting 3D printing technologies to create intricate and complex structures. This allows for more efficient use of materials and opens up new possibilities in design.

Smart Ceramics: Researchers and manufacturers are developing ceramics with enhanced functionalities, such as self-healing capabilities, sensing abilities and even conductive properties. These smart ceramics find applications in various industries, including electronics and healthcare.

Nanotechnology Integration: The incorporation of nanomaterials in ceramics has led to the development of nanoceramics with improved mechanical properties, thermal stability and electrical conductivity. This enhances the performance and versatility of ceramic materials in various applications.

Energy Efficiency: Innovations in glass technology have resulted in the development of energy-efficient glass solutions. This includes low-emissivity coatings and smart glass that can dynamically control light and heat transmission, contributing to energy savings in buildings.

Environmental Sustainability: Sustainability has become a significant focus in the industry, with efforts to incorporate recycled materials into production processes. This helps in reducing the environmental

impact of manufacturing while maintaining product quality.

Bio-Ceramics: In the medical field, there has been a rise in the use of bio-ceramics for applications such as implants and prosthetics. These materials are designed to be compatible with the human body, promoting tissue integration and reducing the risk of rejection.

Augmented Reality (AR) in Glass Manufacturing: Augmented Reality technologies are being employed for quality control and inspection processes in glass manufacturing. This allows for real-time monitoring and identification of defects, improving overall product quality.

Ceramic Matrix Composites (CMCs): Ceramic matrix composites, which combine ceramics with other materials, are gaining traction in high-performance applications such as aerospace and automotive industries due to their excellent strength-to-weight ratio and thermal resistance.

Digitalisation and Industry 4.0: The adoption of Industry 4.0 principles involves integrating Internet of Things (IoT) devices and data analytics in ceramic and glass manufacturing processes. This leads to better process control, predictive maintenance and overall efficiency improvements.

Career Pathways

There are two pathways to pursue a career in the ceramic and glass industry: through a course in design or engineering.

Designing: Ceramic and Glass Designing promises an enriching experience that transcends traditional design education. The curriculum offered by most Indian institutions embraces a multi-faceted approach, fostering engagement with materials, people and technologies. Drawing inspiration from both the rich craft traditions of the country and global art practices, the discipline unfolds a world of possibilities.

As a student, you'll explore the expressive and creative realms of craft, architectural spaces, healthcare, hospitality, home décor, hi-tech products and lifestyle categories. The discipline recognises the potential of ceramic and glass design in future technologies and applications across emerging domains, providing you with a forward-looking perspective.

Importance is also given to meaningful engagement with societal and environmental issues. Graduates are equipped to contribute to social development, embark on entrepreneurial ventures, conduct industrial production and delve into material research. Through this multi-faceted approach, students not only enhance user experiences but also address critical social and environmental challenges, fostering inclusive growth in collaboration with diverse stakeholders.

Upon completion, graduates possess a comprehensive understanding of technology, production techniques and material skills. This prepares

them to navigate a variety of industries, from producing tableware and tiles to sanitary ware and beyond. The skill set acquired also opens avenues for graduates to work with design studios, or venture into the craft sector. Alternatively, they can establish their enterprises, contributing to wealth generation and employment opportunities in the evolving landscape of design and innovation.

Engineering: Through a curriculum that delves into the intricacies of materials, manufacturing processes and cutting-edge technologies, students gain a solid foundation for contributing to advancements in the industry. Engineering-focused approach prepares individuals to tackle challenges related to product innovation, process optimisation and ensuring the reliability of components in high-tech applications. Graduates of Ceramic and Glass Technology Engineering programmes find themselves well-positioned for diverse opportunities in research and development, quality control and the design of innovative materials. The combination of theoretical knowledge and hands-on experience empowers them to make valuable contributions to the ever-evolving landscape of ceramic and glass technology, shaping a rewarding and impactful career.

Courses and Colleges

Several educational institutions offer courses and programmes in ceramic and glass technology, providing students with a strong foundation in the principles and applications of these materials. Most popular among them are:

Institute of Ceramic Technology (ICT), Kolkata: It offers undergraduate and postgraduate programmes in ceramic engineering and technology.

Anna University, Chennai: Anna University's College of Engineering, Guindy, offers a Bachelor of Technology (B.Tech) programme in Ceramic Technology.

National Institute of Technology (NIT), Rourkela: NIT Rourkela offers a Master of Technology (M.Tech) programme in Ceramic Engineering. The curriculum covers various aspects of ceramic science and technology.

Department of Ceramic Engineering, IIT (BHU), Varanasi: This institute offers a 5-year Ceramic Engineering programme.

Government College of Engineering and Ceramic Technology (GCECT), Kolkata: GCECT offers undergraduate and postgraduate courses in ceramic engineering and technology.

Institute of Chemical Technology (ICT), Mumbai: ICT Mumbai offers a Master's programme in Ceramic Engineering and Technology.

Jawaharlal Nehru Technological University (JNTU), Hyderabad: JNTU Hyderabad offers a Bachelor of Technology (B.Tech) programme in Ceramic

Technology, providing students with a comprehensive understanding of ceramic materials and their applications.

National Institute of Design, Ahmedabad: The institute offers a Master's in Designing (M.Des.) in Ceramic and Glass Design.

Visva Bharati University, West Bengal: This University also offers course on Advance Diploma in Design (Ceramic and Glass).

Seth Ganga Sagar Jatia Polytechnic College, Bulandshahr: A renowned institution of higher learning is located in Bulandshahr, Uttar Pradesh offers courses on Ceramic & Glass Design, Production Engineering.

Popular Job Roles for Designing Graduates

- **Product Designer:** Conceptualise and design aesthetically pleasing and functional ceramic and glass products for various applications, including tableware, home décor, lifestyle products and industrial use.
- **Architectural Designer:** Create innovative designs integrating ceramic and glass elements for architectural spaces, contributing to both aesthetics and functionality in buildings.
- **Healthcare Product Designer:** Specialise in designing medical devices and healthcare products using ceramic and glass materials, ensuring both functionality and safety in healthcare environments.
- **Sustainability Designer:** Focus on creating environmentally friendly designs, incorporating sustainable practices and materials to address global ecological concerns.
- **Entrepreneurial Ventures:** Explore opportunities to establish design studios or entrepreneurial ventures, offering custom-designed ceramic and glass products to niche markets.

Popular Job Roles for Engineering Graduates

- **Materials Engineer:** Optimise material properties for ceramic and glass products, ensuring durability, performance and cost-effectiveness.
- **Process Engineer:** Oversee and enhance manufacturing processes, implementing efficiency improvements and maintaining quality standards in the production of ceramic and glassware.
- **Research and Development Engineer:** Drive innovation by conducting research on new materials and technologies, contributing to the development of cutting-edge ceramic and glass products.
- **Quality Control Engineer:** Ensure the reliability and quality of ceramic and glass components through rigorous testing, inspection and adherence to industry standards.
- **Project Manager:** Lead and coordinate projects involving the design and production of

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