

Chapter 24: Ceramics – Traditional & Advanced

Swati Chandrawanshi*

Department of Chemistry, Laxman Prasad Baidh Govt. Girls College Bemetara (CG)

Abstract

The chapter is thorough in terms of the study of ceramics in both the traditional and advanced forms, their composition, the methods of their processing, and their use in industry. Ceramics are lightweight, non-metallic, and highly hard materials that have high thermal stability, corrosion resistance, electrical insulation, and corrosion resistance. The chapter defines ceramics as structural ceramics (purpose of which is bricks, tiles, and refractories) and functional ones (such as superconductors, piezoelectrics, bioceramics). The conventional ceramics are processed by using powder raw materials, shaping, drying and firing whereas the cutting-edge ceramics can use raw materials of high purity, exact sintering, and novel fabrication methods to accomplish some desired mechanical, thermal, and electrical characteristics. Ceramics are used in industrial applications in construction, electronics, biomedical implants, aerospace, and energy applications, and this is a testimony to its versatility and technological significance. The challenges like brittleness, expensive processing, and the quality control are discussed as well as the measures to improve the performance and sustainability. The combination of theoretical concepts and practical projects allows students to develop the profound insight into the nature of ceramic materials, processing techniques, and industrial optimization and prepares them to work in materials science, chemical and ceramic engineering, biomedical technology, and high-tech manufacturing. The chapter highlights the increased importance of sophisticated ceramics in the contemporary industry and technology-based operation.

Keywords: Ceramics, Structural ceramics, Functional ceramics, Advanced ceramics, Bioceramics, Superconductors, Industrial applications.

*Corresponding author

Dr. Swati Chandrawanshi

E-mail address: chemistryswati159@gmail.com

24.1. Introduction

Ceramics are non-metallic materials that are inorganic and made by modeling raw materials like clay, silica and metal oxides and then a high temperature firing and controlled cooling. They are characterized by great hardness, thermal stability, resistance to chemical effect, and extreme conditions as well as durability but usually are brittle in character. Ceramics form also one of the most ancient groups of engineered material that man has utilized. The history of the ceramic artefact has shown that pottery, bricks, and tiles were used as early as 10,000 BC in the ancient world like Mesopotamia, the Indus Valley, China, and Egypt used ceramic artefacts to store, cook, and protect as well as to express themselves. During the era of science and technology as the Industrial Revolution progressed, ceramics represented on the traditional ceramic substances transformed to become scientifically engineered design substances. Controlled electrical, thermal and mechanical properties are now visible in modern ceramics. Ceramics today find essential use in structural production, as bricks, tiles, cement, and refractories; in functional production, electrical insulators, capacitors, piezoelectric devices; and in more recent technology, bio-ceramics used as medical implants, superconductors, electronics and aerospace parts. Their broad usage demonstrates the importance of the ceramics in the contemporary industry and technologies.