

Materials Science: An Overview

Evanjali Pradhan*

Department of Microbiology, Utkal University, Bhubaneswar, Odisha, India

PERSPECTIVE

Materials science, often known as materials science and engineering, is an interdisciplinary field that deals with the design and discovery of novel materials, particularly solids. Materials science has its philosophical roots in the Enlightenment, when academics began to apply analytical reasoning from chemistry, physics, and engineering to old, phenomenological data in metallurgy and mineralogy. Physics, chemistry, and engineering are all still used in materials science. As a result, academic institutions have long regarded the field as a sub-field of these connected fields. Materials science became more widely acknowledged as a distinct branch of science and engineering in the 1940s, and major technical colleges throughout the world established specialized schools to study it. Materials scientists place a premium on comprehending how a material's history affects its structure, and consequently its qualities and performance.

The materials paradigm is a way of thinking about the relationships between processing, structures, and attributes. This paradigm is applied in a range of scientific domains, including nanotechnology, biomaterials, and metallurgy, to increase understanding. Investigating materials, goods, buildings, or components that fail or do not work as intended, resulting in personal injury or property damage, materials science is an important part of forensic engineering and failure analysis. Such investigations are crucial in determining the reasons of numerous aviation accidents and events, for example. The era's preferred material is frequently a defining feature. Stone Age, Bronze Age, Iron Age, and Steel Age are all historical, if arbitrary, terms. Materials science is one of the oldest types of engineering and applied science, coming from the fabrication of ceramics and its probable offshoot metallurgy.

Modern materials science originated straight from metallurgy, which evolved from mining and (possibly) ceramics, as well as the usage of fire in the past. The American scientist Josiah Willard Gibbs demonstrated that the thermodynamic qualities associated to atomic structure in distinct phases are related to the physical properties of a material in the late 19th century, which was a key breakthrough in the understanding of materials. The study and engineering of metallic alloys, as well as silica and carbon materials, employed in manufacturing space ships that enabled the exploration of space, were important products of the Space Race. The creation of innovative technologies such as rubbers, plastics, semiconductors, and biomaterials has been fueled by materials

science. Since then, the discipline has expanded to embrace all types of materials, such as ceramics, polymers, semiconductors, magnetic materials, biomaterials, and nanomaterials, which are divided into three categories: ceramics, metals, and polymers. The active use of computer simulations to develop new materials, forecast properties, and comprehend events has been a significant change in materials science in recent decades.

A material is a substance (usually a solid, but other condensed phases might be included) intended for specific applications. Materials may be found in everything from houses to cars to spacecraft. Metals, semiconductors, ceramics, and polymers are the four major types of material. Nanomaterials, biomaterials, and energy materials, to name a few, are among the new and sophisticated materials being produced. The study of the interplay between the structure of materials, the processing methods used to manufacture those materials, and the resulting material properties is at the heart of materials science. The performance of a material in a certain application is determined by a complicated combination of these factors.

Material performance is influenced by a variety of factors at various length scales, including the chemical constituents that make up the material, its microstructure, and macroscopic processing aspects. Materials scientists use the laws of thermodynamics and kinetics to better understand and develop materials. One of the most essential aspects in the field of materials science is structure. Materials science studies the structure of materials at all scales, from the atomic to the macro. Characterization is the process by which materials scientists study a material's structure. This includes X-ray, electron, and neutron diffraction, as well as many types of spectroscopy and chemical analysis such as Raman spectroscopy, energy-dispersive spectroscopy, chromatography, thermal analysis, electron microscopy analysis, and so on. This is about the atoms in materials and how they are ordered to form molecules, crystals, and other structures. This level of structure is responsible for a large portion of a material's electrical, magnetic, and chemical properties. In this case, the length scales are in angstroms (\AA). Chemical bonding and atomic arrangement (crystallography) are essential for understanding any material's properties and behavior.

Materials scientists must investigate how different atoms, ions, and molecules are ordered and bound to each other in order to fully comprehend the material structure and how it relates to its qualities. Quantum chemistry or quantum physics are studied and used in this process. The science of crystallography is concerned with the

Correspondence to: Evanjali Pradhan, Department of Microbiology, Utkal University, Bhubaneswar, Odisha, India, E-mail: eva.sikha@gmail.com

Received: July 01, 2021, **Accepted:** July 15, 2021, **Published:** July 22, 2021

Citation: Pradhan E (2021). Materials Science: An Overview. J Appl Mech Eng 10:377.

Copyright: © 2021 Pradhan E. This is an open access article distributed under the term of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

arrangement of atoms in crystalline substances. For materials scientists, crystallography is a useful technique. Because the inherent morphologies of crystals reflect the atomic structure, the impacts of the crystalline arrangement of atoms are typically simple to perceive macroscopically in single crystals. Furthermore, crystalline imperfections frequently

regulate physical qualities. Understanding crystal structures is a necessary precondition for comprehending crystallographic faults. Materials are usually found in polycrystalline form, as an aggregate of small crystals or grains with diverse orientations, rather than as a single crystal.