

Material Science : An Overview

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EDITORIAL

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 specialised schools to study it.

Materials scientists emphasize understanding, how the history of a material (processing) influences its structure, and thus the material's properties and performance. The materials paradigm is a way of thinking about the relationships between processing, structure, 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. Originating with the production of ceramics and its potential offshoot metallurgy. One of the oldest branches of engineering and applied science is materials science. 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 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. The basis of materials science is studying the interplay between the structure of materials, the processing methods to make that material, and the resulting material properties. 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 elements that make up the material, its microstructure, and macroscopic processing features. Materials scientists use the laws of thermodynamics and kinetics to better understand and improve 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 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 behaviour.

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. Bonding is also studied using solid-state physics, solid-state chemistry, and physical chemistry.

The science of crystallography is concerned with the 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.

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