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Material science and application

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DESCRIPTION

A material is defined as a substance (most often a solid, but other condensed phases can be included) that is intended to be used for certain applications. There are a myriad of materials around us; they can be found in anything from buildings and cars to spacecraft. The main classes of materials are metals, semiconductors, ceramics and polymers. New and advanced materials that are being developed include nanomaterials, biomaterials, and energy materials to name a few.

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 complex combination of these produce the performance of a material in a specific application. Many features across many length scales impact material performance, from the constituent chemical elements, it's microstructure, and macroscopic features from processing. Together with the laws of thermodynamics and kinetics materials scientists aim to understand and improve materials.

An industrially advanced society uses energy and materials in large amounts. Transportation, heating and cooling, industrial processes, communications—in fact, all the physical characteristics of modern life—depend on the flow and transformation of energy and materials through the techno-economic system. These two flows are inseparably intertwined and form the lifeblood of industrial society. The relationship of materials science to energy usage is pervasive and complex. At every stage of energy production, distribution, conversion, and utilization, materials play an essential role, and often special materials properties are needed. Remarkable growth in the understanding of the properties and structures of materials enables new materials, as well as improvements of old ones, to be developed on a scientific basis, thereby contributing to greater efficiency and lower costs.

Materials science is an interdisciplinary field concerned with the understanding and application of the properties of matter. Materials scientists study the connections between the underlying structure of a material, its properties, its processing methods and its performance in applications.

Countless technical innovations are directly or indirectly linked to novel materials. To fuel continued innovation, researchers want to deepen their understanding of the physical and chemical properties of materials (morphological, structural, magnetic, thermal, and mechanical) at macro-, micro-, and nanoscales.

There are many reasons to understand and improve the properties of materials, thereby increasing their utility and value. Strength, ductility, density, corrosion resistance, and electrical conductance are just a few of the properties that can be vital for enhanced or even entirely new applications of a material.

In the fields of polymer and catalysis research, chemists and chemical engineers want to better understand the relationships between material structure and function at the micro- and nanometer scales. Their discoveries lead to new materials systems with targeted functionality, longer active lifetimes, lower replacement costs, improved strength, and better manufacturability.

The exciting field of nanodevices is focused on developing miniaturized technology with unique functionality for electronic, magnetic, mechanical, and optical systems. Sensors, actuators, and microfluidic devices are all in high demand to help solve global energy, communications, and critical monitoring challenges.

As scientists expand their knowledge of material structures, they also want to understand how materials behave in response to light, temperature, pressure, and other stimuli. Additionally, two-dimensional observations do not always yield answers in a three-dimensional world. Imaging, analysis, and materials characterization must therefore deliver real-world visibility by generating information in 3D under a variety of environmental conditions.

CONCLUSION

It is clear that innovative materials play essential roles in safety, clean energy, transportation, human health, and industrial productivity. Whether exploring alternative energy sources or developing stronger, lighter materials and sophisticated nanodevices, Thermo Fisher Scientific provides a broad range of spectroscopy and electron microscopy tools for the fundamental research and development of new materials.