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Author

Dr. Khalid Sultan
Central University of Kashmir
Department of Physics
Ganderbal, Jammu and Kashmir
191131 Srinagar
India

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Preface

Characterization of materials is the measurement and determination of a material's physical, chemical, mechanical, and microstructural properties. This technique provides the greater degree of awareness required to handle significant issues such as failure causes and process-related concerns, as well as allowing the manufacturer to make critical material decisions. The field of materials characterization is vast and diverse. Perhaps the best place to begin is at the beginning, with the first principle to consider being the depth to which characterization promotes the discovery of new materials:

- Measuring a material's property allows for experimental improvement;
- Taking unique measurements allows for distinction through improvement in specific areas; and
- Understanding the compositional and structural foundations of material attributes allows for rationally designed improvements.

Material characterizations is a crucial step to conduct before using the materials for any purpose. To ensure that the material under consideration can perform without failure during the life of the final product, it might be subjected to mechanical, thermal, chemical, optical, electrical, and other characterizations, depending on the purpose.

This book focuses on the most extensively used experimental approaches for structural, morphological, and spectroscopic characterization of materials. One of the most important aspects of this book is the discussion of

recent results in a wide range of experimental techniques and their application to the quantification of material properties. Furthermore, it covers the practical elements of the analytical techniques used to characterize a wide range of functional materials (both in bulk as well as thin film form) in a simple but thorough manner. For a wide range of readers, from beginners and graduate students to expert specialists in academia and industry, the book gives an overview of frequently used characterization approaches. One of my main aims in preparing this book was to put the basic characterizations used by material research students in the form of a single book. The book is divided into eight chapters.

The first chapter gives the basic ideas of an electromagnetic spectrum, which is important as properties of materials are obtained using the interaction of light with matter. In addition, some fundamentals of crystallography, the magnetic materials, the molecular vibrations, and optical properties in materials have been defined. The second chapter is based on the one and foremost technique used in material sciences and is called the X-ray diffraction technique. After synthesis of any material, the first step is confirmation, which is obtained through the X-ray diffraction pattern. The basic theory, the experimental setup, along with some examples and applications have been included in this chapter. Chapter 3 concerns Raman spectroscopy. In addition to the X-ray diffraction technique, Raman spectroscopy may also be used for the identification of samples. In this chapter, basic theory, the instrumentation of Raman spectrometer, and illustrations are included. Chapter 4 discusses X-ray spectroscopic techniques. Three techniques, namely X-ray absorption spectroscopy, X-ray photoemission spectroscopy, and Auger electron spectroscopy have been explained along with the basic principle and experimental setup for each case.