Preface

Advances in materials science and engineering redefine the boundaries of performance, durability, and functionality across practically all sectors of human activity. This special edition presents five carefully selected thematic areas that collectively reflect both the foundational and emerging innovations in modern materials research. From structural alloys and surface engineering to functional materials and pharmaceutical technologies, the presented chapters here emphasise the interdisciplinary and application-driven nature of contemporary materials science.

Chapter 1: Properties and Processing of Steel and Alloys examines the fundamental relationships between composition, microstructure, processing techniques, and mechanical performance. Special attention is given to thermomechanical treatments, alloy design strategies, phase transformations, and strengthening mechanisms that govern structural integrity and reliability. As steels and advanced alloys remain central to infrastructure, transportation, and energy systems, understanding their behaviour under diverse service conditions is essential.

Chapter 2: Plasma Nitriding of Stainless Steels focuses on advanced surface modification technologies that enhance hardness, wear resistance, fatigue life, and corrosion resistance. Plasma nitriding represents a significant development in surface engineering, highlighting the critical role of surface engineering in extending component lifespan

Chapter 3: Tribology addresses the science of friction, wear, and lubrication - phenomena that directly influence the efficiency and durability of mechanical systems. The chapter integrates theoretical foundations with practical considerations, including surface interactions, contact mechanics, lubrication regimes, and material selection strategies. Given that tribological failures account for significant economic and energy losses globally, advancements in this field contribute substantially to the sustainability and operational efficiency of machines and equipment.

Chapter 4: Functional and Special Materials expands the discussion beyond structural performance to materials designed for specific functional properties. The chapter underscores how tailored microstructures and novel processing techniques enable materials to meet increasingly specialised technological demands.

Chapter 5: Materials for Pharmaceutical Application explores the critical role of materials in drug delivery systems. Emphasis is placed on biocompatibility, controlled release mechanisms, polymeric carriers, nanomaterials, and regulatory considerations.

It is our hope that this edition will serve as a valuable resource for researchers, practitioners, and graduate students seeking both a fundamental understanding and practical insights into the evolving landscape of materials science.