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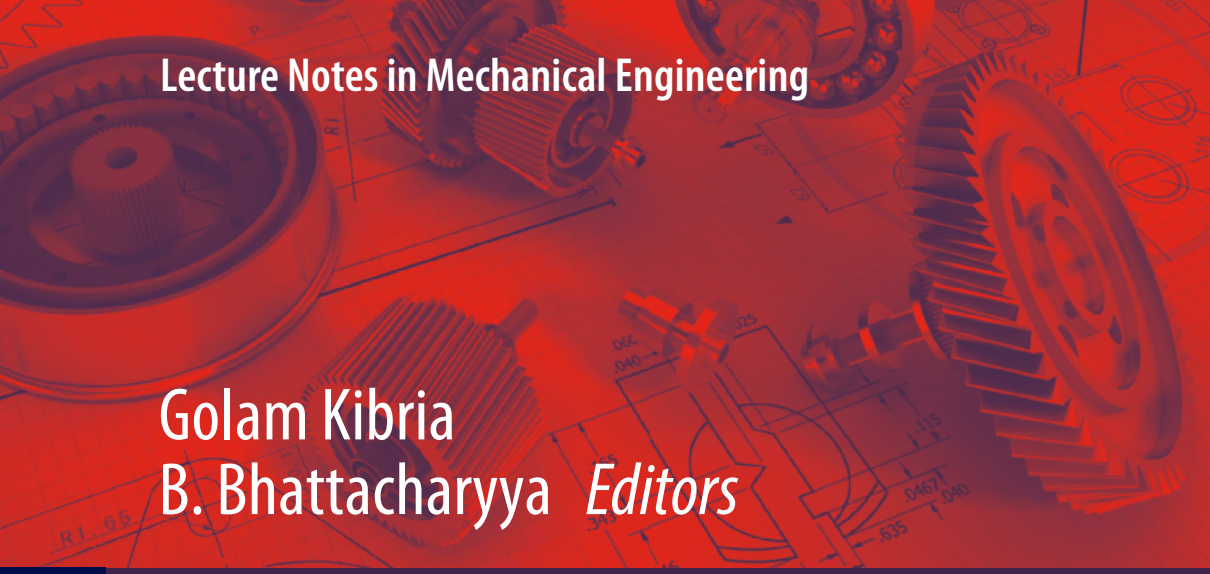

Golam Kibria
B. Bhattacharyya *Editors*

Accuracy Enhancement Technologies for Micromachining Processes

Springer

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Preface

Research challenges and developments in the direction of micromanufacturing of macro- and micro-components for successful applications in the fields of biomedical, microelectronics, optical, automotive, and aerospace are increasing day by day due to the demand of fulfillment of such components with specific surface features, dimensional accuracy, tolerance, and complex shapes. For this, a lot of research activities in micromachining, as well as the development of micromachines, are needed across the globe. Achieving desired surface finish, intricate profiles with accuracy and tolerance, and geometrical dimensions is always a challenging task for the manufacturing technocrats and research scientists. Since inception, a lot of micromachining processes have been developed for achieving the mentioned requirements for the products. However, due to the lack of complete understanding of the physical phenomenon behind the processes, such degree of precision, geometrical features, and surface characteristics have not been attained even today. The development of materials with enormous material properties is also playing the influencing factor of these deficiencies. A few research activities have been performed by research scientists to implement novel strategies in micromachining for augmenting these features related to quality, dimensional accuracy, and productivity. Some of the strategies have also been successfully employed in several micromachining techniques.

The present book entitled *Accuracy Enhancement Technologies for Micromachining Processes* attempts to collect research activities in different conventional as well as non-conventional micromachining processes implementing various novel machining strategies for improving the accuracy and features of components. Chapter "Accuracy Improvement in Tool-Based Micromachining" describes the methodologies of accuracy improvement in tool-based micromachining processes such as micro-turning, micro-drilling, and micro-milling for achieving defect-free components and desired surface finish and accuracy. In chapter "Strategies for Improving Performance of Ultrasonic Micromachining Process," the details of technologies of accuracy improvements in ultrasonic micromachining are described with several developments in the process mechanism itself such as rotary USM, workpiece vibration for the intention to achieve a high degree of accuracy and

surface profile. In chapter "Accuracy Improvement and Precision Measurement on Micro-EDM," the details of micro-electrical discharge machining with its performance and operating parameters are described upon which the accuracy of machining depends on. Further, this chapter also deals with discussions on several factors that cause inaccuracies in micro-EDM. Chapter "Improvement of Profile Accuracy in WEDM—A Novel Technique" deals with accuracy improvement techniques in wire electrical discharge machining process for cutting different complex profiles. Authors developed a new method of detection of wire lag phenomenon and proposed mathematical models to compensate for the inaccuracy in profile cutting. Chapter "Laser-based Fabrication of Micro-channels" deals with the description of possibilities of inaccuracies during the generation of micro-channels utilizing high-power laser beam. Authors have also discussed the underwater laser micro-channeling process and techniques to improve the profile accuracy. Chapter "Pulsed Nd:YAG Laser Cutting: Accuracy Improvement and Parametric Influences" describes the possibilities of accuracy improvement during Nd:YAG laser cutting of a variety of materials ranging from metals, non-metals, ceramics, composites, etc, for establishing the reliability of Nd:YAG laser cutting process. Chapter "Improvement in Surface Finish and Geometrical Accuracy by Laser Micro-turning" describes the novel technique to improve the dimensional accuracy and surface finish during micro-turning process utilizing pulsed Nd:YAG laser. Authors have carried out detailed experimental investigation and analysis to improve surface features of laser micro-turning components made of alumina ceramics. "Accuracy Improvement Techniques in Electrochemical Micromachining (EMM)" describes the details of accuracy improvement techniques for micromachining using electrochemical phenomena. Authors have proposed several novel strategies to augment the geometrical accuracy and surface features. Microtool insulation, IEG control, design, and development of microtool have been proposed by the authors. In chapter "Surface Micromachining—Advances and Advanced Characterization Techniques," the accuracy issues in various surface micromachining methods such as photolithography, reactive ion etching, deep reactive ion etching, as well as some advanced methods of micromachining such as focused ion beam fabrication, electron beam lithography, are discussed. Chapter "Generation of Nano-level Surface Finish by Advanced Nanofinishing Processes" presents details of several advanced nanofinishing techniques such as abrasive flow finishing, magnetic abrasive finishing, and magnetorheological abrasive flow finishing for the in-depth understanding of the processes as well as for improving surface characteristics in nano-finishing techniques.

Therefore, the present book offers a comprehensive overview of various micromachining techniques and accuracy improvement techniques/strategies for increasing the value addition of micro- and macro-products. This book will definitely draw innovative and valuable reference to engineers and R&D researchers attached to micromachining processes. Moreover, the book can be used as a reference book for final-year undergraduate engineering courses and a course of micromachining processes at the postgraduate level. Furthermore, this book can

serve as a useful reference for academics, researchers, mechanical, manufacturing, industrial and materials engineers, professionals in micromachining processes, and related industries.

The editors acknowledge Springer for providing this opportunity and for their enthusiastic and professional support. Finally, the editors would like to thank all the chapters' contributors for their availability to complete this work.

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Golam Kibria
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