

Preface

The capability of plastic deformation of materials had been used for fabrication of parts and products in ancient times by using hammer to deform metallic materials for making simple tools. Nowadays, this capability of materials is ubiquitously and extensively used in mass production of parts and components in many industries, ranging from automobile, aerospace, consumer electronics, home appliances, to medical devices, etc., with tremendously high productivity. This traditional metal forming technology, however, has been linked to long years of apprenticeship and skilled craftsmanship, and the design and development paradigm appeared to be more heuristic know-how and trial-and-error than in-depth scientific calculation, analysis, and simulation. With the advent of numerical simulation technology and the in-depth understanding of the science behind the forming processes, the traditional design and development paradigm of metal forming products has shifted from the experience-based one to the currently more knowledge-based paradigm.

In the present metal forming arena, one of the bottleneck issues is the difficulty in fabrication of large- and small-scale components. For the former, it requires a great capacity of forming equipment, costly tooling set, and time-consuming billet preparation. How to ensure “design right the first time” is very critical as any design changes of the deformed part, process route, preform, and tooling would lead to the significant increase of production cost and design and development lead-times. For the latter, viz., the fabrication of small-scale components, it needs new forming process, the so-called micro-scaled plastic deformation or micro-forming. Due to the overwhelming product miniaturization, the development of feasible, viable, reliable, and efficient microforming processes is critical to provide a large quantity of microparts to meet the increasing demand for microparts in different industrial clusters. On the other hand, microforming is a new forming arena. The traditional existing knowledge, know-how, and systems and tools in macro-scaled forming may not be fully valid and efficient in micro-scaled forming. The new knowledge system of microforming and the in-depth understanding of the process need to be established.

Recently, extensive researches on microforming have been conducted in both academia and industry. The in-depth understanding of size effects and deformation behaviors in microforming processes have been extensively explored and investigated. Many efforts have been also provided in development of microforming

processes and the realization. A systematic understanding of this technology and a relatively complete knowledge system have been established. This book aims to report the state-of-the-art research and development of microforming technology, which includes size effects and size effect affected deformation behaviors and phenomena, the newly developed microforming processes for fabrication of bulk and sheet metal microparts, flow-induced defects, and microforming of bulk metallic glasses.

In this book, [Chap. 1](#) first introduces size effects and the size effect affected deformation behaviors and phenomena in microforming processes. The developed microforming processes for fabrication of bulk and sheet metal microparts are presented. The flow-induced defects and the microforming of bulk metallic glasses are further articulated. In [Chap. 2](#), the modeling and in-depth understanding of the size effects and their affected deformation behaviors and phenomena are extensively described. [Chapter 3](#) summarizes the frictional mechanism and phenomenon in microforming. [Chapter 4](#) elaborates the developed microforming processes for fabrication of sheet and bulk metal microparts. The detailed process and tooling realization, process performance, deformation behaviors in the processes, and the quality of micro-formed parts are comprehensively presented. For the flow-induced defects in microforming, the formation mechanism and how to avoid the defects are detailed in [Chap. 5](#). At the end of this book, the discussion on microforming of bulk metallic glasses for making microparts and the detailed process implementation are highlighted in [Chap. 6](#).

Microforming is a promising micromanufacturing process to fabricate microparts via the plastic deformation of materials. This process is becoming more and more important as the demand on microparts is increasing tremendously due to its unique advantages and characteristics and the inexorable trend of product miniaturization in different industrial clusters. Meanwhile, the worldwide efforts from both academia and industry have been provided to research and develop this technology. This book is intended to give the most comprehensive descriptions and thorough articulation of the state-of-the-art microforming technology for researchers and developers in the manufacturing arena. It also provides valuable information and in-depth understanding to the designers and engineers in this challenging and promising micromanufacturing field and can be used as a reference and text for a graduate course. We sincerely hope that through this publication, great efforts from both academia and industry can be provided to further investigate, study, and develop this promising micromanufacturing technology and eventually the technology can go out of the research and development laboratories and be widely used in industries.

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<http://www.springer.com/978-1-4471-6325-1>

Micro-scaled Products Development via Microforming
Deformation Behaviours, Processes, Tooling and its
Realization

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2014, XIII, 175 p. 191 illus., 131 illus. in color.,

Hardcover

ISBN: 978-1-4471-6325-1