Powder metallurgy fundamentals and sintered materials

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Abstract

The aim of the book: The aim of the book is to present general knowledge on powder metallurgy, taking into especial consideration tool materials made with the use of that technology. The book has been written on the basis of literature review and is a result of many-year didactic experiences of both Authors in that field. The motivation to its publication is also an intention to present the selected results of many-year own researches carried out in the Division of Materials Processing Technologies, Management and Computer Techniques in Materials Science of the Institute of Engineering Materials and Biomaterials of the Silesian University of Technology and experience gained during the realisation of numerous domestic and international research projects, e.g. within the cooperation with one of the best European research centres dealing with powder metallurgy – the University of Carlos III in Madrid.

The content and scope of the book: The book begins with the chapter defining the significance of the selection of materials processing technology and the selection of materials in engineering design and generally in manufacturing processes of products and their elements. Powder metallurgy has been especially distinguished among those technologies, defining it and presenting fundamental information concerning that technology. The following chapters of the book present information and results of own research, concerning the improvement of utility properties of sintered tool materials, such as high-speed steels, steel matrix composites reinforced by carbides, cemented carbides, cermets, ceramic and super hard materials as well as both gradient materials investigated within last few years and also made with selective laser sintering methods and new technologies of forming and powder sintering, among others: PIM method (Powder Injection Moulding) and MIM method (Metal Injection Moulding). The last part of the book includes instructions for the realisation of laboratory classes.

The scope of laboratory classes: In that part of the book instructions for laboratory classes realised in the framework of subjects: “Fundamentals of materials science”, “Metal materials” and “Ceramic materials” and within specialist classes including several following subjects have been presented. The realisation of the aim of the classes presented in the instruction will enable students to familiarise themselves in details with powder technological properties, classic compaction and sintering technologies, modern methods of injection, non-pressure and extrusion moulding and a unique selective laser sintering methods. Mentioned new technologies and full laboratory equipment being at the disposal of the Institute of Engineering Materials and Biomaterials ensure the high level of realised classes, which will result with rich knowledge and high skills gained by students.

Reference to this monograph should be given in the following way:

Recent developments in high-technology areas have significantly transformed the welding industry. The materials used in automotive engines are required to fulfill a multitude of functions. It is a subtle balance between material properties, essential design and high performance characteristics. The intention here is to describe the metallurgy, surface modification, wear resistance, and chemical composition of these materials. The solid phases undergo undesirable structural changes, such as fusion, sintering, and excessive reduction of internal porosity and surface area, as temperature becomes too high.

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Alymov M.I., Shustov V.S., Ustyukhin A.S., Evstratov E.V. Correlation between the quality of nanopowders and productivity rate for fabrication technology of them. Figure 1. Powder metallurgy production routes. Powder Metallurgy and Sintered Materials. 3. requirements (see, e.g., [4]), whereas some properties, especially mechanical properties, can be inferior to those of, e.g., wrought and machined parts. The main benefit of PM is economical: For large production runs of precision components, PM is frequently more cost-effective than classical metalworking techniques. The classical method of metal powder production is ore reduction (already performed in the early iron age (→ Iron, 1. Fundamentals and Principles of Reduction Processes; → Iron, 2. Blast Furnace Process; → Iron, 4. Smelting Reduction Processes). The starting product is purified iron ore (magnetite, Fe₃O₄). The. 8 Powder Metallurgy and Sintered Materials. Figure 10. Powder metallurgy (PM) of biomaterials is still a niche market, but considerable progress in related manufacturing technologies opens up the possibility of participating in the emerging market for medical devices and surgical implants within the next decade. PM technologies like metal injection moulding (MIM) are promising manufacturing routes if large quantities of complex-shaped parts are required. In addition, porous implants or coatings that improve implant fixation by bone ingrowth are preferentially made by PM technologies. In this chapter, the most promising PM routes for biomedical app The book presents the fundamentals and the role of powder metallurgy in contemporary technologies and the state of the art of classical powder metallurgy technologies and a general description of new variants and special and hybrid technologies used in powder metallurgy. The next part includes over a dozen case studies provided in the following chapters, comprehensively describing authors' accomplishments of numerous teams from different countries across the world in advanced research areas relating to powder metallurgy and to special and hybrid technologies. Open access peer-reviewed. 2. Fabrication Technologies of the Sintered Materials Including Materials for Medical and Dental Application.
Powder metallurgy (PM) is a term covering a wide range of ways in which materials or components are made from metal powders. PM processes can avoid, or greatly reduce, the need to use metal removal processes, thereby drastically reducing yield losses in manufacture and often resulting in lower costs. Powder metallurgy is also used to make unique materials impossible to get from melting or forming in other ways. A very important product of this type is tungsten carbide (WC). WC is used to cut and form Fundamentals of metallurgy. Related titles: New developments in advanced welding (ISBN-13: 978-1-85573-970-3; ISBN-10: 1-85573-970-4) Recent developments in high-technology areas have significantly transformed the welding industry. The materials used in automotive engines are required to fulfill a multitude of functions. It is a subtle balance between material properties, essential design and high performance characteristics. The intention here is to describe the metallurgy, surface modification, wear resistance, and chemical composition of these materials. The solid phases undergo undesirable structural changes, such as fusion, sintering, and excessive reduction of internal porosity and surface area, as temperature becomes too high. The sintering process in powder metallurgy is a form of heat treatment. A conventional sintering process heats up the material to just below its melting point. A precise sintering temperature allows the metals to keep their beneficial properties while fusing them tightly together. Think of sintering like a glass of ice water. While the ice cubes do melt eventually, they first fuse together at each point of contact. If you want to dig into more specific powder metal materials, we suggest you start with our favorite branch of materials -- soft magnetic composites: They may just be the key to taking your electric engine design to another level: (Editor's note: This article was originally published in January 2018 and was recently updated.) Powder steels have been used for knife making for more than 30 years. Over the years, the price of such steel has significantly decreased; they have become more affordable and applicable in a variety of knives, including not only the premium segment. What is the difference between powdered steel and “normal” and how is it made? Powdered steel is steel that is sprayed in an inert gas, then the suspension is fed to a special mold, and then the resulting micro-ingots are pressed at ultra-high temperatures and sintered in a special furnace. As a result of these actions, the so-called pow... Powder metallurgy process can be applied to not only metal materials but also ceramics and organic materials, which both are employed as structural and electrical products. Author contributions to Powder metallurgy present excellent and significantly important research topics to evaluate various properties and performance of P/M materials for applying these materials as actual components. In particular, the life estimation of P/M ferrous materials by sliding contact fatigue test and tribological performance evaluation of P/M semi-metallic materials are focused and introduced in this book. Kats
Lecture # 6 POWDER METALLURGY

The Characterization of Engineering Powders

Production of Metallic Powders

Conventional Pressing and Sintering

Alternative Pressing and Sintering Techniques

Materials and Products for PM

Design Considerations in Powder Metallurgy.

1. Powder Metallurgy (PM)

Metal processing technology in which parts are produced from metallic powders. Usual PM production sequence: Pressing - powders are compressed into desired shape to produce green compact. Accomplished in press using punch-and-die. Sintering - green compacts are heated to bond the particles into a hard, rigid mass. Focuses on scientific bases for powder metallurgy and development of new powder and composite materials as well as advanced powder materials and coatings technology. Gives special attention to structural non-oxide and functional oxide ceramics. Develops topics on nano-disperse state of substance. Brings topical publications on physical-chemical and structural study of materials. Journal information. Editor-in-Chief.

Powder metallurgy is the process of blending fine powdered materials, pressing them into a desired shape (compacting), and then heating the compressed material in a controlled atmosphere to bond the material (sintering). The powder metallurgy process generally consists of four basic steps: (1) powder manufacture, (2) powder blending, (3) compacting, (4) sintering. Compacting is generally performed at room temperature, and the elevated-temperature process of sintering is usually conducted at atmospheric pressure. Optional secondary processing often follows to obtain special properties or enhance...
Powder metallurgy process can be applied to not only metal materials but also ceramics and organic materials, which both are employed as structural and electrical products. Author contributions to Powder metallurgy present excellent and significantly important research topics to evaluate various properties and performance of P/M materials for applying these materials as actual components. In particular, the life estimation of P/M ferrous materials by sliding contact fatigue test and tribological performance evaluation of P/M semi-metallic materials are focused and introduced in this book. Kats Focuses on scientific bases for powder metallurgy and development of new powder and composite materials as well as advanced powder materials and coatings technology. Gives special attention to structural non-oxide and functional oxide ceramics. Develops topics on nano-disperse state of substance. Brings topical publications on physical-chemical and structural study of materials. Journal information. Editor-in-Chief. In powder metallurgy of superalloys and titanium materials, the commercial success depends upon selection of suitable techniques for powder production as well as for powder processing. View. Show abstract. The Sinter/HIP process is a technology for sintering and post densification in one cycle with low pressures. It is a beneficial and economical method for the production of dense and homogeneous materials. Sinter/HIP may be a favored technology for polyphase materials, such as cemented carbides, heavy metal alloys or ceramics, which consist at the sintering temperature of hard grains and a highly mobile or viscous phase. Figure 1. Powder metallurgy production routes. Powder Metallurgy and Sintered Materials. 3. requirements (see, e.g., [4]), whereas some properties, especially mechanical properties, can be inferior to those of, e.g., wrought and machined parts. The main benefit of PM is economical: For large production runs of precision components, PM is frequently more cost-effective than classical metalworking techniques. The classical method of metal powder production is ore reduction (already performed in the early iron age (→ Iron, 1. Fundamentals and Principles of Reduction Processes; → Iron, 2. Blast Furnace Process; → Iron, 4. Smelting Reduction Processes). The starting product is purified iron ore (magnetite, Fe₃O₄).