

Article

Optimization of Flat-Rolling Parameters for Thermally Stable Alloy of Al-Cu-Mn System with Micro Additions of Si and Zr

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Abstract: The phase composition, microstructure, and mechanical properties of flat-rolled experimental Al-Cu-Mn system alloy with Si and Zr additions have been studied. The experimental results have been compared with data for the AA2219 commercial alloy pertaining to the same alloying system. Hot deformation of an experimental alloy causes the precipitation of ~100 nm sized dispersoids and refinement of the eutectic phase particles. The yield strength and relative elongation of the hot-deformed experimental alloy are 255 MPa and 8.6%, respectively. Subsequent cold deformation reduces the relative elongation by 3.5% and increases the yield strength by 50 MPa, while the ultimate tensile strength does not change. After long-term 350 °C exposure, the mechanical properties of the experimental alloy remain the same as those of the as-deformed one, whereas the yield strength of the 2219 alloy decreases by 2 times and the ultimate tensile strength by 1.4 times. Comparison of these experimental results with data for the 2219 alloy and other Al-Cu-Mn system alloys cited in this work and reported elsewhere suggests that a good thermal stability of Al-2Cu-2Mn-0.4Si-0.2Zr alloy rolled stock can be achieved through treatment using the regimes designed herein.

Keywords: aluminum alloy; Al-Cu-Mn system; deformation; thermostability; microstructure; mechanical properties



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1. Introduction

Aluminum and its alloys are widely used in a number of branches due to their unique combination of mechanical and physical properties, high processability, and, most importantly, low cost and abundance. Deformable 2xxx series aluminum alloys (Al-Cu and Al-Cu-Mn) have found broad application in the aircraft and spacecraft industries due to the possibility of their long-term operation over a wide temperature range without compromise in performance [1]. The 2219 (Al-6Cu-Mn) alloy of the abovementioned series is still commonly used as a construction material for operation at elevated (up to 315 °C) and cryogenic temperatures [2]. However, high performance of AA2219 alloy products can only be achieved after combined heat and deformation treatment including ingot homogenization, quenching, and aging of deformed semi-finished products [3]. This process route requires strict adherence to the processing parameters, which is difficult to realize in the conditions of large industrial enterprises and their narrow process windows, as it increases the overall time consumption and cost of production and dictates the necessity to use special process equipment. Furthermore, there are indications that the strength of this alloy decreases dramatically at elevated temperatures (above 200 °C) [4,5].

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The Immunoassay Handbook David Wild, 2005-06-20 Containing updated and new information on advanced technology including micro and nanoscale immunoassays this text provides a mix of practical information coupled with a review of clinical applications and practical examples Microparticle Reagent Optimization Caryl Griffin, Jim Sutor, Bruce Shull, 1994

Micro/Nano Devices for Chemical Analysis Manabu Tokeshi, Kiichi Sato, 2018-07-03 This book is a printed edition of the Special Issue Micro Nano Devices for Chemical Analysis that was published in *Micromachines* Journal of the Optical Society of America , 2000 **Nanobiomaterials in Clinical Dentistry** Karthikeyan Subramani, Waqar Ahmed, 2012-12-31 New nanomaterials are leading to a range of emerging dental treatments that utilize more biomimetic materials that more closely duplicate natural tooth structure or bone in the case of implants This book brings together an international team of experts from the fields of materials science nanotechnology and dentistry to explain these new materials and their applications for the restoration fixation replacement or regeneration of hard and soft tissues in and about the oral cavity and craniofacial region The main topics covered include applications in dental specialties Orthodontics Endodontics Pediatric dentistry Periodontics Prosthodontics and Implant dentistry salivary diagnostics using bioMEMS NEMS systems nanochips for oral cancer diagnosis biomimetic nanomaterials and nanotechnology for tooth repair and regeneration The editors previous book *Emerging Nanotechnologies in Dentistry* focused on the fabrication manufacturing processes of materials and dentistry applications This second book complements the first covers with coverage of the range of nanomaterials available today in clinical dentistry explaining the innovative techniques and applications in all of the main clinical dental specialties Nanobiomaterial engineers biomedical researchers biomedical engineers and dental oral pre clinical and clinical researchers will find the comprehensive coverage essential for working with nanotechnologies and materials in both clinical and research settings Book prepared by an interdisciplinary and international group of scientists and practitioners in the fields of nanomaterials dental implants medical devices and clinical practice Comprehensive professional reference for the subject covering materials fabrication and use of materials for all major diagnostic and therapeutic dental applications repair restoration regeneration implants and prevention Complements the editors previous book on nanotechnology applications for dentistry **Microplastics in Water and Wastewater** Hrisi K. Karapanagioti, Ioannis K. Kalavrouziotis, 2019-09-15 This book covers the topic of microplastics in water and wastewater The chapters start with introductory issues related to the growing interest in the scientific community on microplastics and the human water cycle and point out where the microplastics could interact with water The subsequent chapters examine evidence of the microplastic presence in freshwater such as in both rivers and lakes in freshwater biota and hazardous chemicals associated with microplastics in such systems Another set of chapters discuss the presence of microplastics in wastewater their sources their transfer through a wastewater treatment plant the concentration of microplastics in effluents throughout the world the plastic

biomedia used in wastewater treatment plants and the effect on the surrounding environment of effluent wastewater pipes. These chapters also discuss the sampling methods, the sample treatment and analysis techniques used so far for microplastics in wastewater. Additionally, the presence of microplastics in sewage sludge and in soils irrigated with wastewater or fertilized with sludge are discussed. The possible impact of plastics and their additives on plants, microalgae and humans are reviewed and presented in a critical way. Finally, a chapter summarizes all the relevant regulations and initiatives that point to the necessity of a global directive for the protection of the environment from plastic and microplastic pollution. The topic of microplastics in freshwater systems and in wastewater has scarcely been studied and requires more attention. *Microplastics in Water and Wastewater* aims to bring these initial findings to the attention of a broader audience and especially to operators and managers of freshwater and wastewater systems. It will also be helpful to people already aware of the marine debris problem to understand the sources of microplastics in the oceans from freshwater systems and wastewater treatment plants.

Manual of Clinical Laboratory Immunology Noel R. Rose, 1997. Reflects changes being thrust upon the laboratory community.

Lab-on-a-Chip Fabrication and Application Margarita Stoytcheva, Roumen Zlatev, 2016-06-29. The necessity of on-site fast sensitive and cheap complex laboratory analysis associated with the advances in the microfabrication technologies and the microfluidics made it possible for the creation of the innovative device lab on a chip LOC by which we would be able to scale a single or multiple laboratory processes down to a chip format. The present book is dedicated to the LOC devices from two points of view: LOC fabrication and LOC application.

Henry's Clinical Diagnosis and Management by Laboratory Methods E-Book Richard A. McPherson, Matthew R. Pincus, 2021-06-09. For more than 100 years *Henry's Clinical Diagnosis and Management by Laboratory Methods* has been recognized as the premier text in clinical laboratory medicine, widely used by both clinical pathologists and laboratory technicians. Leading experts in each testing discipline clearly explain procedures and how they are used both to formulate clinical diagnoses and to plan patient medical care and long-term management. Employing a multidisciplinary approach, it provides cutting-edge coverage of automation, informatics, molecular diagnostics, proteomics, laboratory management, and quality control, emphasizing new testing methodologies throughout. Remains the most comprehensive and authoritative text on every aspect of the clinical laboratory and the scientific foundation and clinical application of today's complete range of laboratory tests. Updates include current hot topics and advances in clinical laboratory practices, including new and extended applications to diagnosis and management. New content covers next-generation mass spectroscopy, MS coagulation testing, next-generation sequencing, NGS transfusion medicine, genetics, and cell-free DNA, therapeutic antibodies targeted to tumors, and new regulations such as ICD-10 coding for billing and reimbursement. Emphasizes the clinical interpretation of laboratory data to assist the clinician in patient management. Organizes chapters by organ system for quick access and highlights information with full-color illustrations, tables, and diagrams. Provides guidance on error detection, correction, and prevention, as well as cost-effective test selection.

Includes a chapter on Toxicology and Therapeutic Drug Monitoring that discusses the necessity of testing for therapeutic drugs that are more frequently being abused by users Enhanced eBook version included with purchase Your enhanced eBook allows you to access all of the text figures and references from the book on a variety of devices [Meeting Abstracts](#) Electrochemical Society. Meeting,1999 **Manual of Clinical Microbiology** Patrick R. Murray, Ellen Jo Baron, 2003 Includes information on infection detection and prevention and control diagnostic technologies bacteriology antibacterial antiviral antifungal and antiparasitic agents and susceptibility test methods virology mycology and parasitology **Surgical Endocrinology** John Lynn, Stephen Robert Bloom, 1993 Surgical Endocrinology presents the fundamentals and practical application of the subject matter It discusses the molecular background and physiology of the endocrine systems It addresses the legal aspects of endocrine surgery such as duty of care and breach of such duty Some of the topics covered in the book are the principles of endocrine surgery molecular structures of organisms physiology of endocrine system multiple endocrine neoplasia and molecular genetics non surgical management of pituitary tumors assay formulations and automation technology syndrome of ectopic hormone produ [ASM Handbook](#) ASM International. Handbook Committee, 1990 These volumes cover the properties processing and applications of metals and nonmetallic engineering materials They are designed to provide the authoritative information and data necessary for the appropriate selection of materials to meet critical design and performance criteria **Genetic Engineering News** ,2005 *Laboratory Practice* ,1992 **Covalently Modified Antigens and Antibodies in Diagnosis and Therapy** Gerard A. Quash, John D. Rodwell, 1989 Based on a symposium in Lyon France in June 1989 Eleven papers survey the use of antibodies vaccines and anti ideotypes in tumor therapy discuss a variety of immunoconjugates for diagnosis and therapy in which the antibodies are coupled to a range of proteins chemotherapeutic agents and isotypes and explore a series of systems in which antibodies and or antigens are used in in vitro diagnostic or therapeutic procedures Of interest to researchers in a wide range of medical and biological fields Annotation c 2003 Book News Inc Portland OR booknews com [Nucleonics](#) ,1961 [Government Reports Announcements & Index](#) ,1993-06 **American Laboratory** ,2007 **Chemical Engineering Progress** ,1962

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