

A REVIEW ON MACHINING PROCESS OF GLASS MATERIALS

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Abstract — This paper provides an intensive literature review to enhance machining process on brittle materials glass taken into consideration. The paper starts with the classification of current & past manufacturing processes based on the processes being used for machining of glass material. The major part of this paper reviews existing machining processes used machined to glass material reported over the past two decades. Finally this paper attempts to identify output results with respective their machining process.

I. INTRODUCTION

Glasses used as key structural material for optical, bio and chemical devices due to their excellent & superior properties such as high strength, hardness thermal resistance, corrosion resistance, wear resistance, relatively light weight high chemical and heat resistance, high electrical isolation, low optical absorption, amorphous solid material, large optical transmission range and biocompatibility [6][9][12][34][38][35]. However, such materials are generally difficult-to-machine due to the properties of extreme hardness, brittleness[27][6][9][19]. Glass also has the distinction of being transparent and having low electrical as well as thermal conductivity. It is increasingly being used in micro fabricated devices like solid oxide fuel cells, pumps, optics, electronics part, biomedical diagnostics, thermodynamics fluidics reactors, micro-electromechanical systems(MEMS)[24][25][33][37][14][19]

II. CLASSIFICATION OF MACHINING PROCESS

A. Abrasive Water Jet Machining (AWJM)

The Authors investigated on machining of borosilicate glass by AWJM. Depth of cut is measured with different machine parameter of water pressure, abrasive flow rate, traverse speed and standoff distance. Particle swarm optimization is used to for optimization parameters [1]. The Surface roughness and kerf taper ratio aspect were studied of machining of glass/epoxy composite laminate Material & also produce a better quality of cuts for that Taguchi's design tool used for experiments and analysis of variance[2]. The taper of cut slot increases with increase in standoff distance. Garnet abrasives produce a larger taper of cut followed by Al_2O_3 and SiC. The taper of the cut also increases with increase in work feed rate. The average width of cut produced by SiC is higher

in this case[15]. Micro machining and fluid polishing of glass using stagnation produced under the jet nozzle by using this technique crack-free machining of micro grooves & polishing of micro channels was done[21]

B. Micro Abrasive Air Jet Machining (MAJM)

Predictive mathematical models for the erosion rates in micro-hole drilling and micro-channel cutting on glasses with an abrasive air jet are developed. This model prediction provides better experimental results[10]. The Authors conducted Machining of glass by abrasive jet machining while the glass is cooled to a low temperature by using a liquid Nitrogen. Due to this technique Material removal rate of glass was increased [22]. The experimented results shows that micro-grooving on glass. Results obtaining that combination of the fine-tuning of the masking process & MAJM. This is applicable for micro-machining of semiconductors, electronic devices & LCD[27]. The author optimized machining parameters such as Standoff distance, Pressures and different Nozzle Diameters by using Taguchi Method & this method compared to Analysis of Variance(ANOVA). The output results found out MRR & KERF[30]. In this paper discusses abrasive-jet machining of glass by using silicon carbide or aluminium oxide abrasives were mixed with air & directed at high velocity onto the glass and because of that optimum MRR was found to be 10mg/min[32]. The Author has been produced Analytical models for prediction of the shape, sidewall slope, and depth of abrasive jet micro-machined planar areas. In that developing two techniques (i) machining micro-channels adjacent to the planned planar area, and (ii) Target oscillation with an obliquely. This technique used for machining of flat planar areas at a single elevation [11]

C. Abrasive Slurry Jet Micro Machining(ASJM)

The authors studied the effect of dilute polymer solutions on the width, shape, and centreline roughness of micro-channels machined using new developed abrasive slurry-jet micro-machining (ASJM) apparatus. The results found out little

Chapter 2 Machining Of Glass Materials An Overview

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Advanced Manufacturing Technologies Kapil Gupta, 2017-04-29 This book provides details and collective information on working principle process mechanism salient features and unique applications of various advanced manufacturing techniques and processes belong The book is divided in three sessions covering modern machining methods advanced repair and joining techniques and finally sustainable manufacturing The latest trends and research aspects of those fields are highlighted

Micromachining Using Electrochemical Discharge Phenomenon Rolf Wuthrich, Jana D. Abou Ziki, 2014-11-08 Micro machining is an advanced manufacturing technique of growing importance and adoption of micro machining using electrochemical discharges Micro ECDM has increased steadily in recent years Among new developments is the interest of industry in Micro ECDM However the potential of the technology is not being fully utilized and there is no comprehensive reference book available today covering it Micromachining Using Electrochemical Discharge Phenomenon Second Edition fills this gap It is unique in its detailed coverage of all aspects of the Micro ECDM process as well as Spark Assisted Chemical Engraving SACE As such it covers technologies such as chemical etching micro drilling and other material removal mechanisms high aspect ratio machining design and construction of the machining apparatus and a wide range of applications The new edition compares Micro ECDM and SACE with other micromachining technologies such as laser machining and traditional EDM ECDM is used for machining of electrically non conductive materials Micro ECDM SACE is mainly applied to glass and the book focuses on glass but the authors also present new results on other materials such as ceramics In addition techniques to modify material properties for the machining process are explained The authors discuss machining strategies including the latest developments in micro texturing of glass micro channels and reports on developments in controlling and analysis aspects of machining This book is a unique reference for engineers and industrial researchers involved in development design and use of micromachining chemical micro drilling or chemical engraving techniques and equipment Only all encompassing reference covering Micro ECDM and SACE available on the market Covers a wide range of applications including applications in the MEMS industry and the Medical Devices and Medical Diagnostics industries New edition includes expanded sections on comparing Micro ECDM SACE with other micromachining technologies

Abrasive Technology Anna Rudawska, 2018-10-24 The subject matter of this book is the information on the abrasive technology methods the characteristics of the methods for example the technological parameters tools and machines innovative methods characteristics of surface structure and surface properties after this type of mechanical process and application in various industrial branches and other technical and technological domains Abrasive technology is very important for example in precision component manufacturing and nano technology devices The aim of this book is to present information on the characteristics and applications of abrasive technology abrasive tools tests and also the innovative methods of this technology This information enables scientists engineers and designers to ensure the soundness and integrity

of the fabricated components and to develop new techniques effectively

Hybrid Micromachining and Microfabrication Technologies Sandip Kumar, Golam Kibria, Prasenjit Chatterjee, Asma Perveen, 2023-05-04 HYBRID MICROMACHINING and MICROFABRICATION TECHNOLOGIES The book aims to provide a thorough understanding of numerous advanced hybrid micromachining and microfabrication techniques as well as future directions providing researchers and engineers who work in hybrid micromachining with a much appreciated orientation The book is dedicated to advanced hybrid micromachining and microfabrication technologies by detailing principals techniques processes conditions research advances research challenges and opportunities for various types of advanced hybrid micromachining and microfabrication It discusses the mechanisms of material removal supported by experimental validation Constructional features of hybrid micromachining setup suitable for industrial micromachining applications are explained Separate chapters are devoted to different advanced hybrid micromachining and microfabrication to design and development of micro tools which is one of the most vital components in advanced hybrid micromachining and which can also be used for various micro and nano applications Power supply and other major factors which influence advanced hybrid micromachining processes are covered and research findings concerning the improvement of machining accuracy and efficiency are reported

Ultraprecision Machining and Metrology Jiwang Yan, 2025-09-23 This comprehensive introduction to ultraprecision machining and metrology provides an essential foundation for students and engineers offering an in depth analysis of key methods technologies and practical applications Ultraprecision machining is a critical enabling technology for producing high value mechanical optical optoelectronic and biomedical components with complex geometries and extreme precision This book delivers a structured exploration of ultraprecision machining and metrology covering essential topics such as system configuration tooling machining mechanism modeling and surface characterization Dedicated chapters on surface and subsurface metrology as well as the machinability of both ductile and brittle materials make it an indispensable resource for understanding machine design manufacturing processes and related materials science Ideal for students and researchers this book serves as a vital reference for those working in precision machining MEMS advanced manufacturing and precision metrology

Polymer Matrix Composites: Materials Usage, Design, and Analysis Composite Materials Handbook - 17 (CMH-17), 2025-10-16 The third volume of this six volume compendium provides methodologies and lessons learned for the design analysis manufacture and field support of fiber reinforced polymeric matrix composite structures It also provides guidance on material and process specifications and procedures for using the data that is presented in Volume 2 The information provided is consistent with the guidance provided in Volume 1 and is an extensive compilation of the current knowledge and experiences of engineers and scientists from industry government and academia who are active in composites The Composite Materials Handbook referred to by industry groups as CMH 17 is a six volume engineering reference tool that contains over 1 000 records of the latest test data for polymer matrix metal matrix ceramic matrix and structural sandwich

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