

Article

Experimental Study of Electrolytic Processing of Discharge-Assisted Jet Masks

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Abstract: There has been some research on jet electrolytic processing at home and abroad, and the phenomenon of discharge during the process has been reported, but there has been little research on the mode of jet electrolysis with the aid of discharge. A jet mask electrolytic processing experiment was set up to prepare a blue oil mask on the surface of the workpiece using photolithography; two processing modes were achieved using different tool electrodes, the workpiece was processed by two types of motion, the processing micro-pits were observed morphologically using an optical microscope, and the test data were analyzed by plotting graphs. Experiments show that a blue oil mask with a thickness of 50 μm covers the workpiece to strengthen the fixity, and that jet electrolytic discharge machining can effectively improve the depth-to-width ratio by increasing the contribution to depth by 30%–38% and the contribution to width by 2%–18%, compared to jet electrolytic machining. The former has less island effect than the latter, with a flatter bottom and better-machined shape.

Keywords: jet electrolytic machining; in-line dressing of electrical discharges; workpiece morphology analysis



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1. Introduction

Jet electrolytic machining (Jet-ECM) is a special form of electrochemical machining (ECM) that uses an electrolytic jet as a tool. It offers advantages over other electrochemical machining processes such as good domain fixation, high machining speeds, and machining position flexibility [1,2]. The use of a displacement stage to drive the nozzle cathode to follow a pre-defined path enables rapid and precise fabrication of complex structures on the workpiece surface [3–5]. Hinduja and Pattavanitch [6] electrochemically machined a simple square pocket and a pocket with a humanoid protrusion, using tools with round and square electrodes. Hacker-Oschätzchen et al. [7] used a continuous electrolytic free jet to obtain a high degree of positioning in the removal area and electrochemically processed cavities with a depth of about 180 μm and a width of about 190 μm . Kawanaka and Kunieda [8] investigated the effect of current conditions and nozzle movement speed on the surface roughness of stainless steel, and achieved a mirror-like surface with Rz surface values of less than 0.2 μm . It was shown that the surface roughness of the cavities decreased as the nozzle translation speed increased, and that for constant speeds the surface roughness of the cavities decreased and increased again after reaching a minimum value [8–10].

Electrochemical discharge machining (ECDM) is considered to be a hybrid machining method. Material removal is based on two phenomena: electrochemical dissolution of the material and corrosion due to hot inter-electrode discharge [11,12]. Kim et al. [13] proposed an ECDM drilling method for glass workpieces, where a working fluid containing potassium hydroxide facilitated the process. Kobayashi [14] described a solution for obtaining shaped cavities by ECDM and electro-corrosion, using an electrolyte based on sodium

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Table of Contents Study Of Relaxation In Electrolytic Solu

1. Understanding the eBook Study Of Relaxation In Electrolytic Solu
 - The Rise of Digital Reading Study Of Relaxation In Electrolytic Solu
 - Advantages of eBooks Over Traditional Books
2. Identifying Study Of Relaxation In Electrolytic Solu
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Study Of Relaxation In Electrolytic Solu
 - User-Friendly Interface
4. Exploring eBook Recommendations from Study Of Relaxation In Electrolytic Solu
 - Personalized Recommendations
 - Study Of Relaxation In Electrolytic Solu User Reviews and Ratings
 - Study Of Relaxation In Electrolytic Solu and Bestseller Lists

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 - Study Of Relaxation In Electrolytic Solu eBook Subscription Services
 - Study Of Relaxation In Electrolytic Solu Budget-Friendly Options
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 - Study Of Relaxation In Electrolytic Solu Compatibility with Devices
 - Study Of Relaxation In Electrolytic Solu Enhanced eBook Features
7. Enhancing Your Reading Experience
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 - Highlighting and Note-Taking Study Of Relaxation In Electrolytic Solu
 - Interactive Elements Study Of Relaxation In Electrolytic Solu
8. Staying Engaged with Study Of Relaxation In Electrolytic Solu
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Study Of Relaxation In Electrolytic Solu
9. Balancing eBooks and Physical Books Study Of Relaxation In Electrolytic Solu
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Study Of Relaxation In Electrolytic Solu
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Study Of Relaxation In Electrolytic Solu
 - Setting Reading Goals Study Of Relaxation In Electrolytic Solu
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Study Of Relaxation In Electrolytic Solu
 - Fact-Checking eBook Content of Study Of Relaxation In Electrolytic Solu
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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