

Research on contact mask electrochemical machining technology based on dynamic coupling of electric field and flow field by wireless sensor node data acquisition

Ruoqi Li

Institute of overseas education, Nnjtech university, Nanjing, 211816, China

2117528917@qq.com

Abstract

Wireless sensor node data acquisition is based on computer communication technology, making full use of remote control software to enter the service terminal, so as to achieve the purpose of remote control using the Internet. In order to realize the real-time control of dynamic contact mask electrochemical machining process, this paper proposes to use wireless sensor nodes for data acquisition. It mainly includes data acquisition module, data processing module and parameter adjustment module. The data acquisition module focuses on acquiring the electrolyte temperature, electrolyte pressure, current value and voltage value of the processing area, and discriminates the data to eliminate the gross error signal. Therefore, it is necessary to conduct a comprehensive experimental analysis of the results of the theoretical research, and gradually revise the basic theoretical model according to the experimental results, so as to ensure that the theoretical model can sensitively and accurately respond to the changes of characteristic parameters. The real-time control is realized through the organic coordination of each module of the online control system, so as to ensure the machining quality of the dynamic contact mask electrochemical machining technology in the practical engineering application.

Keywords

Wireless sensor, Mask electrochemical machining technology, data acquisition.

1. Introduction

With the continuous development of wireless sensor network technology, people's ways of obtaining and processing information are changing with each passing day, and people's contact with computers is becoming closer and closer. Wireless sensor network is built on the basis of a large number of sensor nodes, and gradually improves simultaneous interpreting of different sensor technologies and functions to form a free and flexible network organization structure. Nodes can collect information through the intelligent perception of the regional environment, and use the transmission protocol to transmit the data information to the receiving end. The data will be routed to the central server through the data receiver for processing, storage, visualization and interpretation.

Therefore, based on the characteristics of wireless sensor, the wireless sensor node data acquisition is applied to the research of contact mask electrochemical machining technology with dynamic coupling of electric field and flow field.

2. Compare

For the micro slot array structure, the main machining methods include traditional machining, EDM, laser machining, electrochemical machining and so on. Micro groove array structure can

be machined on metal surface by using new diamond tool. [1]The disc type foil electrode EDM technology uses the variation of the loss rate of different metal foil in the tool electrode to process the micro slot array with large aspect ratio on the metal surface. Laser processing technology has the advantages of high processing precision, fast forming speed and wide application range. For the electro-hydraulic beam machining technology[2], it is a non-contact machining of micro groove structure based on the principle of electrolysis. By adjusting the spray angle, good surface quality can be obtained. All of the above methods have their own advantages, but there are still some limitations in machining ultra long micro groove arrays on the surface of thin-walled and difficult to machine materials. One is the use of mechanical force or high energy to remove materials, thin-walled parts are prone to deformation, residual stress, recast layer and other processing defects in the ultra long processing area. On the other hand, it is difficult to achieve efficient and low-cost processing for thousands of densely arranged micro grooves.

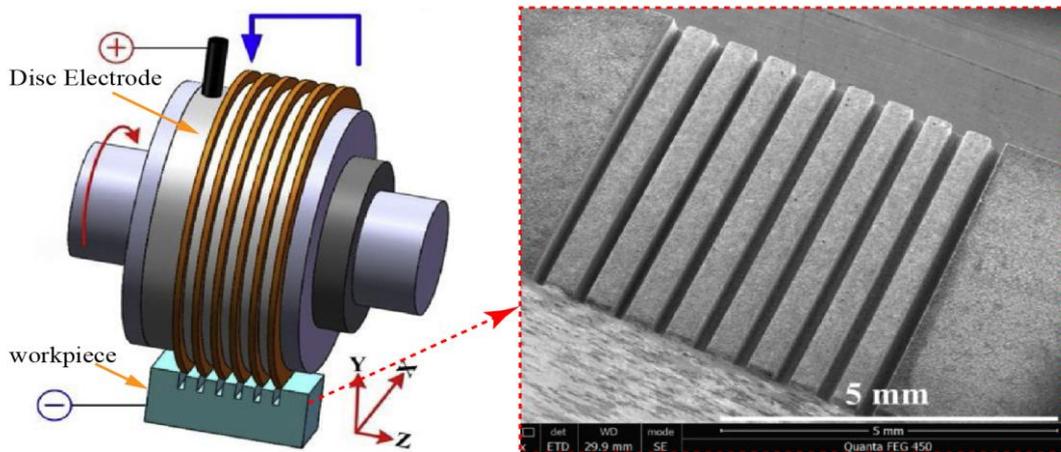


Diagram1 Micro groove structure of EDM array

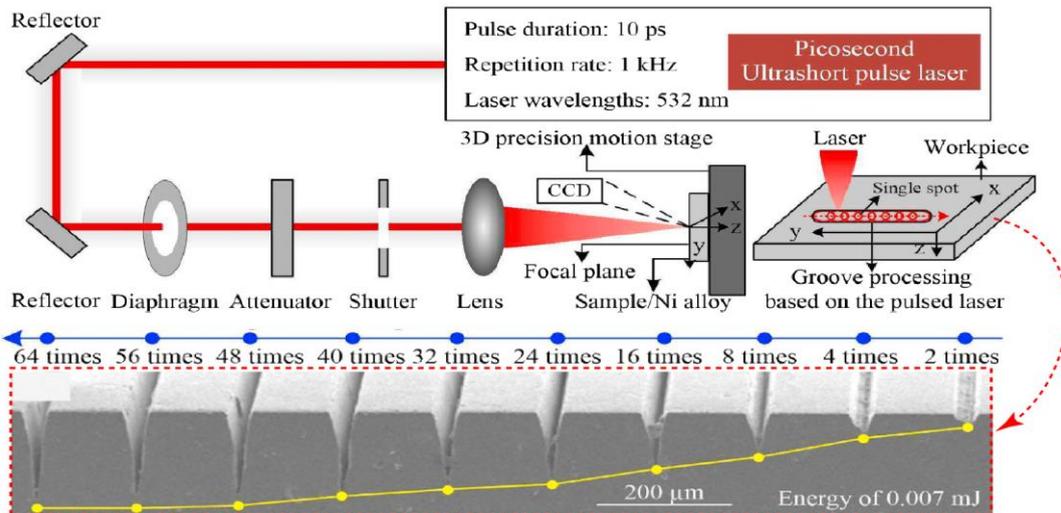


Diagram2 Laser processing array micro groove structure

Compared with the above methods, the mask electrochemical machining technology has unique advantages. The working layer of mask electrochemical machining technology is divided into four layers. From the top to the bottom is Cathode, Electrolyte, Mask, Workpiece. And the Cathode layer is connect with the negative pole of power supply. The Workpiece layer is connect with the positive pole of power supply. The basic principle of mask electrochemical machining is to limit the electrolytic reaction area of anode workpiece by insulating mask, and copy the mask structure to the workpiece by using the dissolution of anode metal in the electrochemical reaction. Because there is no high temperature and high heat in the process,

there is no deformation, residual stress and recast layer; In addition, the mask pattern is the processing area, which is easy to realize the efficient processing of array microstructure.

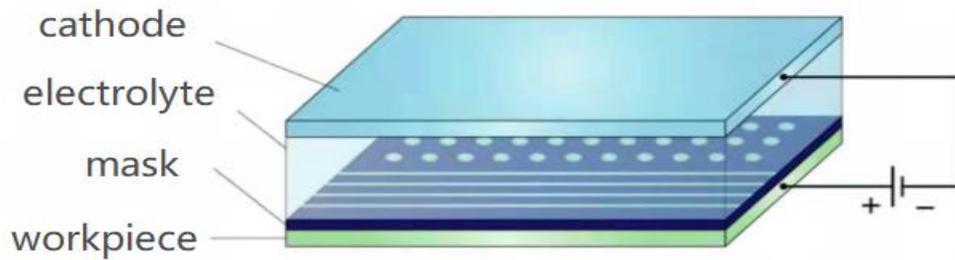


Diagram3 Schematic diagram of mask electrochemical machining

3. Experiment

In order to realize the real-time control of dynamic contact mask electrochemical machining process, this paper proposes to use wireless sensor nodes for data acquisition. It mainly includes data acquisition module, data processing module and parameter adjustment module. The data acquisition module focuses on acquiring the electrolyte temperature, electrolyte pressure, current value and voltage value of the processing area, and discriminates the data to eliminate the gross error signal. The main task of the parameter adjustment module is to send instructions to the processing system according to the processing results of the data processing module to adjust the process parameters. Data processing module is the core module of online control technology, and it is also the difficulty of research.

Wireless sensor node data acquisition is based on computer communication technology, making full use of remote control software to enter the service terminal, so as to achieve the purpose of remote control using the Internet. This technology has the advantage of not being bound by time and space, and plays an important role in liberating a large number of human and material resources and maximizing resource utilization. Therefore, based on the above advantages, this paper studies the contact mask electrochemical machining technology of wireless sensor node data acquisition and dynamic coupling of electric field and flow field.

4. Methods

This project plans to use ZigBee technology, using microcontroller sending node to receive the signal source information, and process its data format, and then transmit the data to coordinator node through point-to-point wireless transmission. The coordinator node is used to collect the received parameter data, and then transmit it to the host through the wireless node debugging interface board.

Then we process the collected data.

The main task of the data processing module is to calculate the deviation between each characteristic parameter and the theoretical value, and then calculate the maximum error value that may appear in the processing result according to the deviation. If the calculation result exceeds the allowable error, the adjustment amount of the corresponding processing parameter is calculated through the theoretical model simulation, and the corresponding command signal is output. The research of basic science can provide a basic theoretical model for data processing module, but the actual processing situation is more complex, and various non processing factors will also affect the characteristic parameters. Therefore, it is necessary to conduct a comprehensive experimental analysis of the results of the theoretical research, and gradually revise the basic theoretical model according to the experimental results, so as to

ensure that the theoretical model can sensitively and accurately respond to the changes of characteristic parameters. The real-time control is realized through the organic coordination of each module of the online control system, so as to ensure the machining quality of the dynamic contact mask electrochemical machining technology in the practical engineering application.

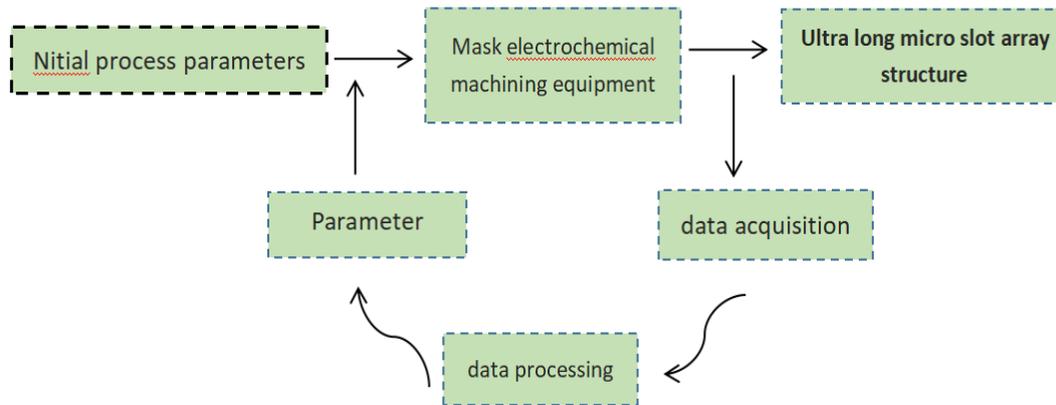


Diagram4 Zigbee model

5. Advantage

ZigBee technology is a new type of short-range wireless communication technology, which has the characteristics of self-organization, dynamic topology, low power consumption and stable transmission. Compared with Bluetooth and other wireless communication technologies, ZigBee technology has incomparable advantages. Under the application of ZigBee technology, technicians set up multiple nodes on the electronic device, install them into the device, and use computer and other information technology to build a complete wireless sensor network system. It is convenient for technicians to obtain the parameters of electrolyte temperature, electrolyte pressure, current value and voltage value in the processing area, and screen the data, eliminate the gross error signal, and carry out the follow-up research on contact mask electrochemical machining technology for dynamic coupling of electric field and flow field.

Conclusion

Wireless sensor network can be well used in the research of contact mask electrochemical machining technology with dynamic coupling of electric field and flow field. Using the special properties of wireless sensor network nodes, unmanned data acquisition can be effectively realized in the mask electrochemical machining process. The experimental speed is greatly improved, and the artificial pressure can be effectively relieved.

Acknowledgements

I would like to express my gratitude to all those who helped me during my writing. Thanks for my school, NJtech university of Technology Undergraduate Innovation and Entrepreneurship Competition for giving me this opportunity. My project fund number is 202110291121Y.

References

- [1] Jiang J, Luo T, Zhang G, et al. Novel tool offset fly cutting straight-groove-type micro structure arrays[J]. Journal of Materials Processing Technology, 2021, 288:116900.

- [2] Zhao W, Wang L, Yu Z, et al. A processing technology of grooves by picosecond ultrashort pulse laser in Ni alloy: Enhancing efficiency and quality[J]. Optics & Laser Technology, 2019, 111:214-221.