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Effect of Magnetic Head Shape on Processing of Titanium Alloy Wire by Magnetic Abrasive Finishing

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Abstract: Titanium alloy wire is characterized by high specific strength, good corrosion resistance, high-temperature resistance and other excellent comprehensive performance. It has been widely used not only in aerospace, shipbuilding and other high-tech fields, but also increasingly in medical equipment, food safety and other fields. Because titanium alloy wire is relatively difficult to process, it has a large deformation resistance, good elasticity, high flexion ratio and more serious rebound. During the processing, adhesion problems may occur, thus reducing the surface quality. The magnetic abrasive finishing (MAF) has good flexible machining characteristics. In this study, the rotating magnetic field was loaded on the titanium alloy wire, and the magnetic abrasive was absorbed by the magnetic field force to form a magnetic abrasive brush, so as to realize the precision processing of the titanium alloy wire. Under the same processing time, when the angle of the magnetic head was 37°, the surface roughness of titanium alloy wire was reduced to 0.28 μm by MAF, which improved the processing quality and efficiency of the titanium alloy wire.

Keywords: magnetic abrasive finishing; titanium alloy; abrasive behavior; surface roughness

1. Introduction

Titanium alloy wire is widely used in medical and health, the military industry and other fields because of its advantages, such as small density, high specific strength and good corrosion resistance. However, due to the limitation of current titanium alloy wire manufacturing, surface defects such as bulges and edges are produced during the reproduction process [1–5]. When titanium alloy wire with defects on the surface is used, it causes instability of the equipment and a certain degree of corrosion in the depression of the titanium alloy wire, thus reducing the service life. Huang et al. [6] obtained better surface integrity by electrolytic polishing of nickel-titanium alloy. However, the electrolyte causes greater pollution to the environment. Krishnan et al. [7,8] used ion implantation to improve the surface quality and to reduce the surface roughness of nickel-titanium wire and titanium wire. However, ion-implantation equipment is highly expensive, the atmosphere used is toxic and the depth of ion implantation is difficult to control. In recent years, some scholars found that magnetic abrasive finishing (MAF) has a significant impact on the surface processing of the difficult-to-machine profiles [9,10]. However, the diameter of titanium alloy wire is too small, making it crucial to ensure that the magnetic abrasive has enough grinding pressure on titanium alloy wire. In the traditional magnetic abrasive finishing process [11–22], the square magnetic head is usually used. In the process of polishing titanium alloy wire, due to the small diameter of titanium alloy wire, the pressure of the magnetic abrasive on titanium alloy wire cannot be guaranteed, which affects the processing effect and reduces the processing efficiency. A magnetic head with an angle can change the distribution of the magnetic field in the processing area, and the titanium alloy wire with a smaller diameter can be processed accurately. In addition, a magnetic head with a taper angle can change the distribution of