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Removal model of Rotation & Revolution Type Polishing Method

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Highlights

- The RRP method which meets increasing demands for high-quality aspherical optics.
- The RRP method can maintain tool shapes and uniformly generate the surface roughness.
- Experiments were conducted to prove the effectiveness of mathematic models.

Abstract: This paper introduces and discusses the Rotation and Revolution Polishing (RRP) method which meets increasing demands for high quality aspherical optics and higher precision polishing techniques by its unique machining positions and tool shapes. The RRP method is a promising precision polishing method as it can stably maintain polishing tool shapes and uniformly generate the surface roughness by through optimum polishing velocity distribution. Experiments were conducted to determine and prove the of effectiveness of mathematic models on polished profiles based on the Preston equation under diverse conditions.

Keywords: Finishing, Material removal rate, Polishing models, Deterministic Polishing, RRP

1.Introduction

To meet increasing demands for high quality aspherical optics, the authors are developing higher precision polishing techniques [1]-[3]. High profile accuracy and high quality surface are achieved by stable polishing volume as well as the tools used, they are difficult to realize using conventional soft tools[4]-[7]. As for new methods, such as MRF[8],[9], EEM[10]-[13], although they are able to provide smooth surfaces in the final polishing stage, they are both complex and costly processes, thus use is limited.

On the other hand, the RRP method overcomes the drawbacks of conventional soft tools by its unique machining positions and tool shapes, and is able to meet the needs for stable polishing rates, which means that smooth polishing surface of workpieces can be achieved stably [14]-[17]. In this study, we propose an empirical formula for the removal profile based on the Preston equation [18]-[21], and proved by experiments that we can precisely control polishing shapes.

2.Principles and methods

Two movements of polishing tools, rotation and revolution were combined in this research. As shown in Figure 1, polishing can be either on circular faces(left) or curved faces(right). Polishing in the radial direction of the contact surface will produce a difference in speed, resulting in unstable material removal, however, machining the workpiece with the circumferential surface, the polishing orientation is variable depending on the size and shape of the workpiece. Rotation Revolution type polishing methods, which combine the two movements talked above, are able to meet the needs for stable polishing rates thus make sure the smooth of workpiece polishing surface.

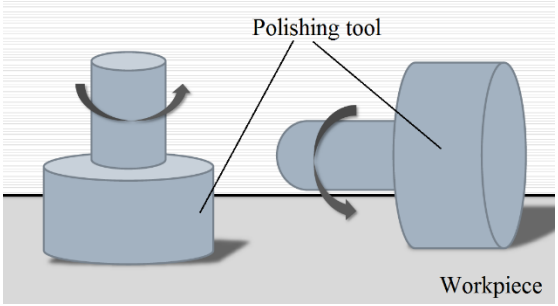

Fig.1 Schematic of single-axes polishing methods

Fig. 2 shows the tube-shaped tool. As shown, the revolution and rotation axes maintain a certain angle in the same plane.