Study on the variable pressure CCOS polishing technology

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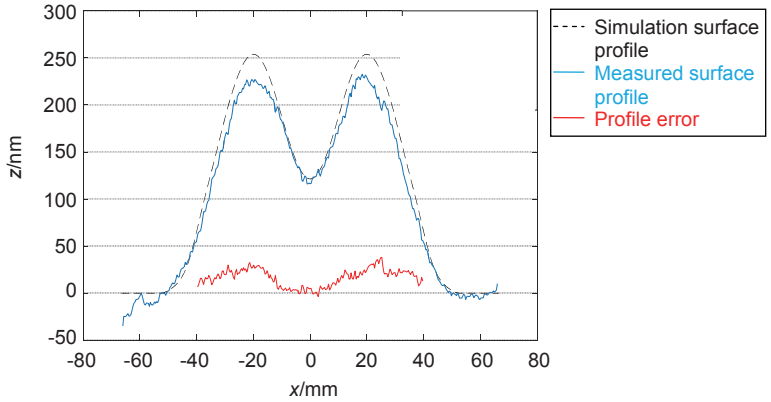

Measured and simulated machined surface profile and profile error

Overview: The aspherical and freeform surface mirror, as one of the key elements in optical system, is needed more and more. Both higher figure accuracy and higher fabricating efficiency are demended with the development of the optical systems. In grinding and polishing of the aspherical and freeform surface, the CCOS technology is widely used. It is a process during which errors can be corrected quantificationally by a small tool that can follow the local curves of the aspherical and freeform surface. The CCOS technology commonly uses constant pressure during polishing, and thus the desired amount of material to be removed depends on the dwell time. This paper focuses on the variable pressure CCOS polishing technology. It adds one more degree of freedom to the polishing process, in which the desired amount of material to be removed is controlled by both the polishing pressure and the dwell time. Firstly, a mathematical model was established for the variable pressure polishing process. Then, the stability and response speed of the output force of the polishing tool, and the stability of removal function was measured and analyzed. Finally, a material removal experiment that applied sinusoidal force was carried out on a K9 material mirror. Results show that: 1) The mathematical model for the variable pressure polishing process is correct; 2) Frequency of the measured force is the same as that of the ideal sinusoidal polishing force, with a standard deviation of the force error being about 0.35 N. Its effect on PV and RMS of the finish surface is less than 9%; 3) The spatial period of the measured surface profile is the same as that of surface profile obtained by simulation of the sinusoidal polishing process. The surface profile error is within 17%. In this paper, variable pressure polishing was achieved, and its effectiveness for optical processing was verified. Compared with the constant pressure CCOS polishing technology, the variable pressure CCOS polishing technology adds one more degree of freedom to the polishing process, so it need to control both the polishing pressure and the dwell time. In theory, it can improve processing efficiency and convergence rate. At the same time, it need have higher requirements for the force active control system, such as the output force range, response speed and precision. These performance parameters can affect the processing results. Therefore，the key to developing the variable pressure CCOS polishing technology is to research the polishing tool, which must have high performance force active control system.

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