

Experimental Research on Ultra-Smooth Surface Polishing Based on Two-Dimensional Vibration of Liquid

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Abstract. Experiment research of polishing based on liquid two-dimension vibration is carried out by a vibrating device which is driven by ultrasonic source and can produce coupling vibrations of liquid. Sound pressures of some key points in water are tested by hydrophone and translated into sound intensity to evaluate the effect of input voltage of transducer. It is analyzed which vibration state of fluid field and the way that workpiece is clamped is the best for the polishing. Polishing results of quartz glass are evaluated by the use of region-track measure method, and some polishing rules are presented.

Introduction

Polishing Based on Coupling Vibrations of Liquid (PCVL) is a novel polishing method, which make use of the vibrated fluid to realize the ultra-smooth surface machining. An experimental device has been designed and its basic idea is shown in Fig. 1. In the trough, ultrasonic transducers are arranged on the side and bottom as vibration source of the liquid, and the liquid vibration can impel particles impacting workpiece continuously, then the material can be removed and the ultra-smooth surface will be obtained. [1]

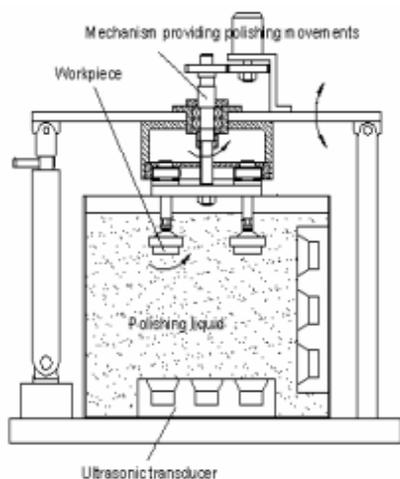


Fig 1 Processing device of PCVL

Fluid-solid coupled analysis on this device was performed using finite element method. From the analysis it could be found that the same voltage should be chosen for the transducer so that the vibration of fluid can be stable. Furthermore, there is a biggish included angle between the vibration trail of fluid and horizontal direction when liquid vibrated stably, this will cause vertical vibration velocity to be faster than horizontal vibration velocity. [2]

The intensity of ultrasonic plays an important role in polishing. When sound intensity is weak, it is difficult to polish the workpiece of high hardness like quartz glass. However, if sound intensity is too powerful, it will not only damage the workpiece, but also form acoustic barrier on acoustic radiation surface [3], therefore it is necessary to test the sound intensity of ultrasonic.

Sound Intensity Test

Three planes within the vibrating trough are selected; they are plane A (bottom of the trough); plane