Polished surfaces measurements for Laser Speckle Methods with Ultraviolet-rays

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1. Introduction

The laser speckle is a method that can measure the vibration of piezoelectric resonators. When the incident angle is about 10 degrees, the laser beam is irradiated on the surface, a full-screen data can be acquired within 20 seconds, so it is able to analysis more accurately. However, a laser speckle method is required rough surfaces only. On the other hand, a laser speckle method is not possible to directly measure the vibration of the polishing surfaces.

In recent years, since piezoelectric device resonators (in particular, quartz crystal resonators) have become smaller and resonator surfaces have gradually become polishing which cannot be measured by laser speckle. Therefore, we tried experiments and simulations in order to improve the use of laser speckle method to measure it.

Previous studies have shown that using the near ultraviolet laser at a wavelength of 400 nm and the incident angle of 30 degrees can get a reflectivity which is 40%[1]. This shows the laser speckle method can be used properly.

In this experiment, two kinds of mirrors of gold and aluminum were selected, which are the most similar to the piezoelectric resonators of polishing surfaces. Using an incident laser, the scattering reflectance ratio for the mirror finished was determined by a detector installed in the vertical direction. Several experiments were carried out using laser-beams of the wavelength 377 nm, 456 nm and 656 nm, at incident angles of 15 and 30 degrees, respectively. As results, the measured data is consistent with the simulation results.

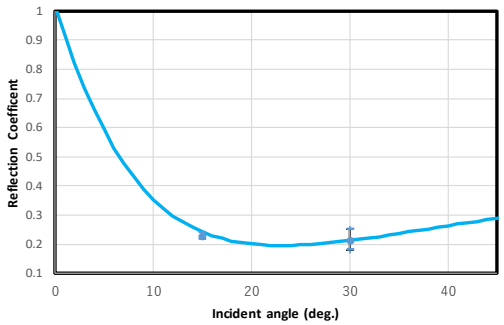
2. Experimental results

Figures 1 (a), (b) and (c) show simulation results of reflectance of three laser-wavelengths at incident angles of 15 deg. and 30 deg. with LD wavelengths of 377 nm, 456 nm and 656 nm, respectively.

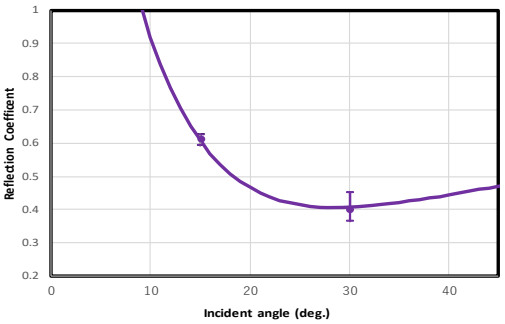
It can be seen from the results that the error between the experimental value and the simulated value is in the range of 1 ～ 2 %.

3. Conclusion

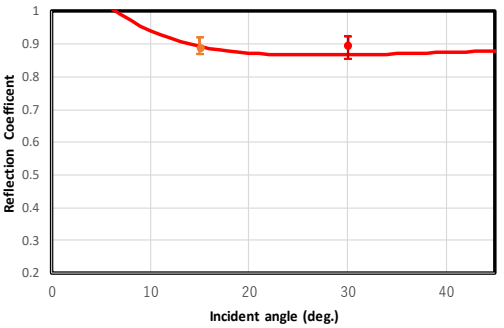
An experiment was conducted on the wavelength variation of LDs including UV wavelengths. The wavelengths of 377nm, 456nm and 656nm were chosen as the laser wavelength, and reflection coefficient were measured respectively. The errors between experimental and simulated values were less than 2 %.



(a) 377 nm



(b) 456 nm



(c) 656 nm

Fig. 1 Experimental results

Acknowledgments

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Reference

1) Yunhao Ma, et. Al., USE2017 1P2-2 (Tagajyo).