Proceedings of the 10th World Congress on Mechanical, Chemical, and Material Engineering (MCM'24)
Barcelona, Spain - August 22-24, 2024
Paper No. ICMIE 123
DOI: 10.11159/icmie24.123

Enhancing Sensitivity in Warpage Measurement and its Application to Mobile Electronic Components

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Extended Abstract

As electronic devices continue to shrink and integrate more densely, the challenge of thermal deformation in electronic packages and assembled circuit boards grows in significance. The shadow moiré method is commonly used for measuring warpage, yet enhancing sensitivity by reducing the grating pitch presents difficulties due to periodic crushing of the moiré pattern caused by light diffraction, known as the Talbot effect, limiting sensitivity. Even when employing white light for shadow moiré measurements, such as a halogen lamp, setting the grating pitch to 25 μm for improved sensitivity renders the moiré pattern unreadable due to a half Talbot distance of less than 0.1 mm.

Previous research on the Talbot distance has primarily focused on evaluating moiré pattern readability based on grating pitch and the incident angle of the light source. This study extends the Talbot distance by considering the wavelength and observation angle of the light source. We established a shadow moiré measurement system using a blue LED light with a shorter wavelength to increase the Talbot distance. Through this LED-based shadow moiré measurement, we achieved high sensitivity of less than 10 μm/fringe in measuring the warpage of a mobile phone's main board. Subsequently, we investigated the influence of sensitivity and Talbot distance on the shadow moiré system by incorporating both observation and incident angles. Experimental results show that, under identical sensitivity conditions, increasing the observation angle from 0 degrees can more than double the Talbot distance. This research advances shadow moiré measurements by offering improved sensitivity and extending Talbot distance, enabling more accurate assessment of electronic device warpage.

* This paper was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) (NRF-2020R1I1A3073955)

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