Theoretical model for surface position estimation for 3-dimensional measurement by autofluorescence confocal detection

Motoya Yoshikawa, Kensuke Kawami, Shotaro Kadoya, Masaki Michihata and Satoru Takahashi

Department of Precision Engineering, The University of Tokyo
7-3-1 Hongo, Bunkyo, Tokyo 113-8656, Japan
yoshikawa.m@nanolab.t.u-tokyo.ac.jp

In recent years, products have become increasingly miniaturized and complex, and many micro components with high aspect ratio structures have become widespread. Simultaneously, there is a growing demand for a method to measure such shapes with less than submicron accuracy. However, measurement of steep and smooth surfaces has general problems such as probe contact angle and light reflection angle. Therefore, we focused on fluorescence as a measurement principle that is not limited by such geometrical constraints. Fluorescence is a phenomenon in which an excited molecule emits the differential energy as light in all directions when it returns to its ground state. Fluorescence emitted from the object itself is particularly called autofluorescence, which is known to be emitted from many materials such as glass and ceramics when UV light is incident. In this study, we propose a method to detect autofluorescence using a confocal system and to estimate the surface position by fitting a model that takes absorption by a sample itself into account. Results of measuring a fluorescent plate show that the method is capable of measurement with residuals of less than 1 μm even on smooth slopes that exceed the focusing angle of the objective lens.

Short biography:

Motoya Yoshikawa graduated from the University of Tokyo in March 2023. He went on to pursue a master's degree at the same university. He is a member of the Japan Society for Precision Engineering. His research topic is geometric measurement using fluorescence.