Vision-based Automatic Alignment of Small-Scale Specimens for High-Throughput Materials Characterizations

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The materials genome projects have been actively conducted to accelerate the establishment of composition-phase-property relationships for broad ranges of material systems [1-3]. In this regard, high-throughput experiments (HTEs) using small scale specimens have the advantage of being more efficient in time and cost than conventional methods. In HTEs, specimens are fabricated within a compact area using MEMs process and repeated measurements are used to quickly determine the materials properties. Therefore, the alignment between the specimen and the measuring probe is important because it can cause significant errors in the measured properties when misaligned [4]. In this study, we developed an automatic alignment system that uses the visual information of each micro-samples acquired from optical microscopes (OM), and demonstrate that this technique can achieve a precise alignment for mechanical HTEs.

For the study, we used a custom made high-throughput indentation system that consists of 3-axis stages, a load cell, and an optical microscope. For the alignment, the visual information of a SiNx square membrane specimen from the OM is processed with LabVIEW. We designed the algorithm to recognize the edges of the specimen by bringing the visual information into the Vision Assistant module of LabVIEW. After measuring the line intensity of the image, we could readily identify the edge section as well as the center point of the specimen (Fig. 1). The location of the specimen was then changed such that the center point matches the probe position. We demonstrate that the maximum error is 15μm when applying the auto-alignment system to the 3mm×3mm specimen array (6 x 12, 67.4 mm x 21 mm), which is a significant improvement compared to the error (720 μm) when the alignment system was not used (Fig. 2).

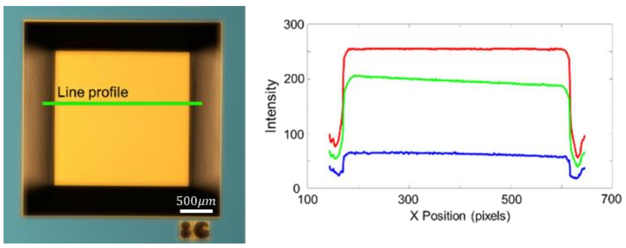

Fig. 2 Photo of the square membrane sample and line intensity profile

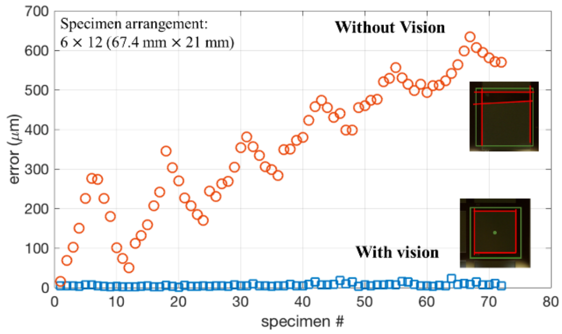

Fig. 1 Alignment error with and without the vision

Acknowledgment : We are grateful to the Basic Science Reasearch Program through the National Research Foundation of Korea (NRF), funded by the Ministry of Science, ICT and Future Planning (NRF-2017R1E1A1A01078324).

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