AFM Technical Presentation with Lunch: Park Systems

Friday, August 26, 2016 @ 11:30am
BRK, ROOM 1001

Ryan (Young-kook) Yoo
Park Systems Inc, 3040 Olcott St, Santa Clara, CA, 95054

Title: High Accuracy Atomic Force Microscope with Self-Optimizing Scan Control

Abstract: Atomic force microscope (AFM) is a very useful instrument in characterizing nanoscale features, However, the original AFM design, based on piezo-tube scanner, had slow response and non-orthogonal behavior, inadequate to address the metrology needs of industrial applications: accuracy, repeatability, and automation. The primary reasons are the poor behavior of piezoelectric tube scanner and the tip wearing that constantly changes the tip geometry. Together with complex setting of operating parameters, AFM could not be made as widely adopted as other microscopy such as optical microscope or scanning electron microscope (SEM).

In order to improve the core performance of AFM, we have developed a flat scan system, where the x-y flexure scanner moves the sample in the horizontal plane and the z flexure scanner moves only the probe in the vertical axis. The accuracy of the x-y scan was improved with feed-forward algorithm, Hann function, and dual servo system. The speed of the z scanner was increased by minimizing the mass of moving part of the scanner to which the probe is attached. The resulting z servo bandwidth was high enough to enable the non-contact mode in ambient atmosphere and made it stable enough to become practical for routine operation. The non-contact mode preserves the sharp tip and, therefore, provides highly accurate and repeatable measurements of the sample geometry through tip de-convolution. AFM is evolving into an ideal methodology for non-destructive sample scan with longer tip life, in various industry applications: pole-tip recession, surface roughness, automatic defect review, etc.

We also developed self-optimizing algorithms for the scan parameters of the non-contact mode, such as servo gain, set-point, and scan speed by analyzing the tip-sample interaction force and the scan data of previous line. In the new AFM system, the user only needs to set the scan area and the z servo error limit that corresponds to the degree of image quality. The new improved AFM not only produced accurate images faster, but also allowed various new industrial applications for HDD and semiconductor industry. Eventually, AFM will become as easy and widely adopted as optical microscope.