Stylus Surface Profilometer

Model: Alfa Step – IQ, KLA-TENCOR, Forevision Technologies, USA

Stylus surface profilometer (Alpha-Step IQ) from the KLA-Tencor Corporation, USA, is a computerized, high-sensitivity surface profiler that measures roughness, waviness, and step height of the thin film in a variety of applications (Fig1a). The Alpha-Step IQ can profile variety of materials, including magnetic disks, semiconductor wafers, precision-machined and polished surfaces, ceramics for micro-electronics, glass for flat panel displays and optical surfaces. The tip of the stylus is diamond tip of radius 2 μm. During the surface scanning, stylus force between 10 and 15 mg and scan speed from 2 to 200 μm/sec can be adjusted depending upon the surface of the sample. The stylus movement over the surface of the sample is detected by the transducer which converts its (stylus) movement into electrical signals (Fig.1b). These electrical signals then go to the analog to digital converter giving digital information about the surface topology onto the computer screen of profilometer.

![Diagram of profilometer](image)

**Fig.1:** (a) Stylus surface profilometer. (b) Schematic of the working principle of profilometer.

Stylus surface profilometer provides the following features:

- Measurement of vertical features (film thickness) ranging from 10 nm to approximately 1 mm, with a vertical resolution of about 1 Å (Fig.2).
- The horizontal or lateral resolution is only limited by the stylus radius and not by the number of data points. The lateral resolution is about 5 μm with maximum scan length is 10 mm.
- Stylus profilometer can give full wafer 2D and 3D stress mapping, allowing accurate measurement on the curved surface of the sample.
The profilometer has ability to repeat a scan up to ten times and automatically calculate the average, thereby minimizing the effects of environmental noise on measurements.

Sample stage of the system is 6-inch round with 360 degree rotation that can accommodate samples up to 6-inch wide and about 20 mm thick.

![Figure 2: Line scan over the sample surface giving step height or film thickness.](image)

The computer of the stylus profilometer offers powerful measurement control, data storage, analysis and networking. Stylus profilometry requires force feedback and physically touching the sample surface during the scanning (contact mode). So while it is extremely sensitive and provides high Z resolution, it is sensitive to soft surfaces and the probe can become contaminated by the surface. This technique can also be destructive to some surfaces such as flexible and soft surfaces. Because a stylus profilometer involves physical movements in X, Y and Z while maintaining contact with the surface, it is slower than non-contact techniques such as optical surface profilometer. The stylus tip size and shape can influence the measurement and limit the lateral resolution.