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Application News

SPM-Nanoa™ Scanning Probe Microscope (Atomic Force Microscope)

The Integrated High Performance Optical Microscope Realizes Smooth Location on SPM

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User Benefits

- The high performance optical microscope integrated into the SPM enables precise target location.
- Accurate target capturing eliminates the need for rework in locating the field of view, realizing more efficient operations.
- Patterned Si substrates can be easily observed without sample preparation.

■ Introduction

Scanning Probe Microscope [SPM (AFM)] is a microscope that enables easy, high-resolution 3D observation at the nano meter scale in air. The range of application is extensive, from hard materials such as semiconductor substrates and metals to soft materials such as biological samples. As the miniaturization of electronic devices and bio-devices progresses, further miniaturization is required for the parts comprising these devices. For example, in the semiconductor industry, the line width of circuits used to be 10 µm when integrated circuits were first developed, but now it is 14 nm. Due to such micronization of parts, the selection of locations to observe with microscopes is now required to be even more precise compared to the past. Since SPM has a high resolution and high magnification, it is necessary to strictly specify the observed location. Although an observed location for SPM is usually selected using an optical microscope, precise positioning has not conventionally been possible, due to the lack of resolution on the optical microscope. However, SPM-Nanoa integrates a high-performance optical microscope, thereby facilitating precise location of the target on the micrometer.

■ SPM-Nanoa

SPM is a microscope that observes and measures the 3D topography and local physical properties of a sample at high magnification by scanning the sample surface with a tiny probe (cantilever). Equipped with an advanced high-sensitivity detection system and automatic observation function as standard, SPM-Nanoa is a new SPM which makes it easier, more detailed, and faster to "observe" what you want to observe. It powerfully assists you in diverse tasks, from observation of the topography of microscopic areas to the measurement of physical properties. Fig. 1 shows the external view of SPM-Nanoa. The three features of SPM-Nanoa are as follows:

① Automatic observation:
Adjusts the optical axis of the laser, sets the conditions during observation, and automates image processing.

② Extensive functionality:
Sharp and clear image both on optical microscope and SPM.

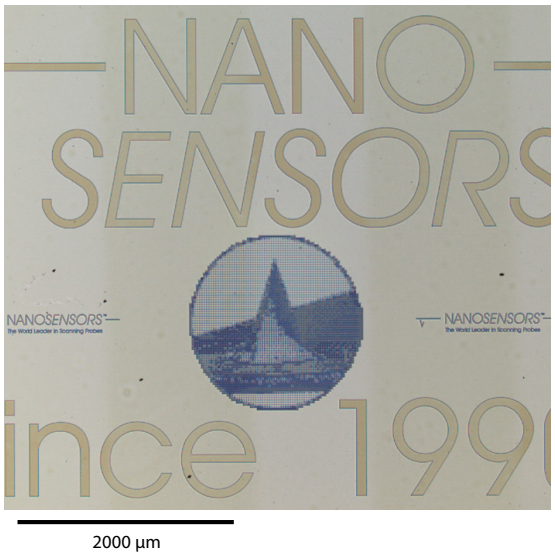
③ Saves time:
Various support functionality achieves fast observation.

In this article, among ② high performance features, we introduce a case where the observation location was selected on the micrometer using the high performance optical microscope, and the microstructure was smoothly observed by SPM.

Fig. 1 SPM-Nanoa™ Scanning Probe Microscope

■ Observation Sample and Conditions

In this article, a patterned Si substrate was observed. Fig. 2 shows the image observed by the optical microscope. An image of a probe is drawn in the center of the substrate, and a portion of the image was observed with SPM-Nanoa. It was possible to make a smooth transition from wide range observation with the integrated high-performance optical microscope to high-resolution observation with SPM, without losing sight of the target.



2000 µm

Fig. 2 Patterned Si Substrate

Table 1 shows the observation conditions. We used the optical microscope to zoom into the image from 600 µm × 600 µm to 200 µm × 200 µm, and then used SPM to further zoom in to 20 µm × 20 µm and 1 µm × 1 µm.

Table 1 Observation Conditions

Instrument	:	SPM-Nanoa Scanning Probe Microscope	
Scanner	:	Wide range scanner (125 µm)	
Observation mode	:	Contact mode	
Observation field	:	Optical microscope	600 µm × 600 µm
			200 µm × 200 µm
		SPM	20 µm × 20 µm
			1 µm × 1 µm

■ Observation Results

Fig. 3 shows the observation results. Figs. 3(a) and (b) show the images observed by the optical microscope. From these observed images, it can be seen that the probe design appearing in the overall substrate image shown in Fig. 2 was composed of various types of pictograms.

Figs. 3(c) and (d) show the surface topography images observed by SPM, and Fig. 3(e) shows the cross-sectional profile. Figs. 3(c) and (e) show that the step height forming a pictogram is about 200 nm. From Figs. 3(d) and (e), it can also be seen that these pictograms are made up of etched holes with a diameter of 218.3 nm and a depth of about 24.2 nm.

■ Conclusion

With its integrated high performance optical microscope, the SPM-Nanoa enables precise location of targets on the order of micrometers. This feature realizes efficient high-resolution observation in SPM.

Sample provided by NanoSensors

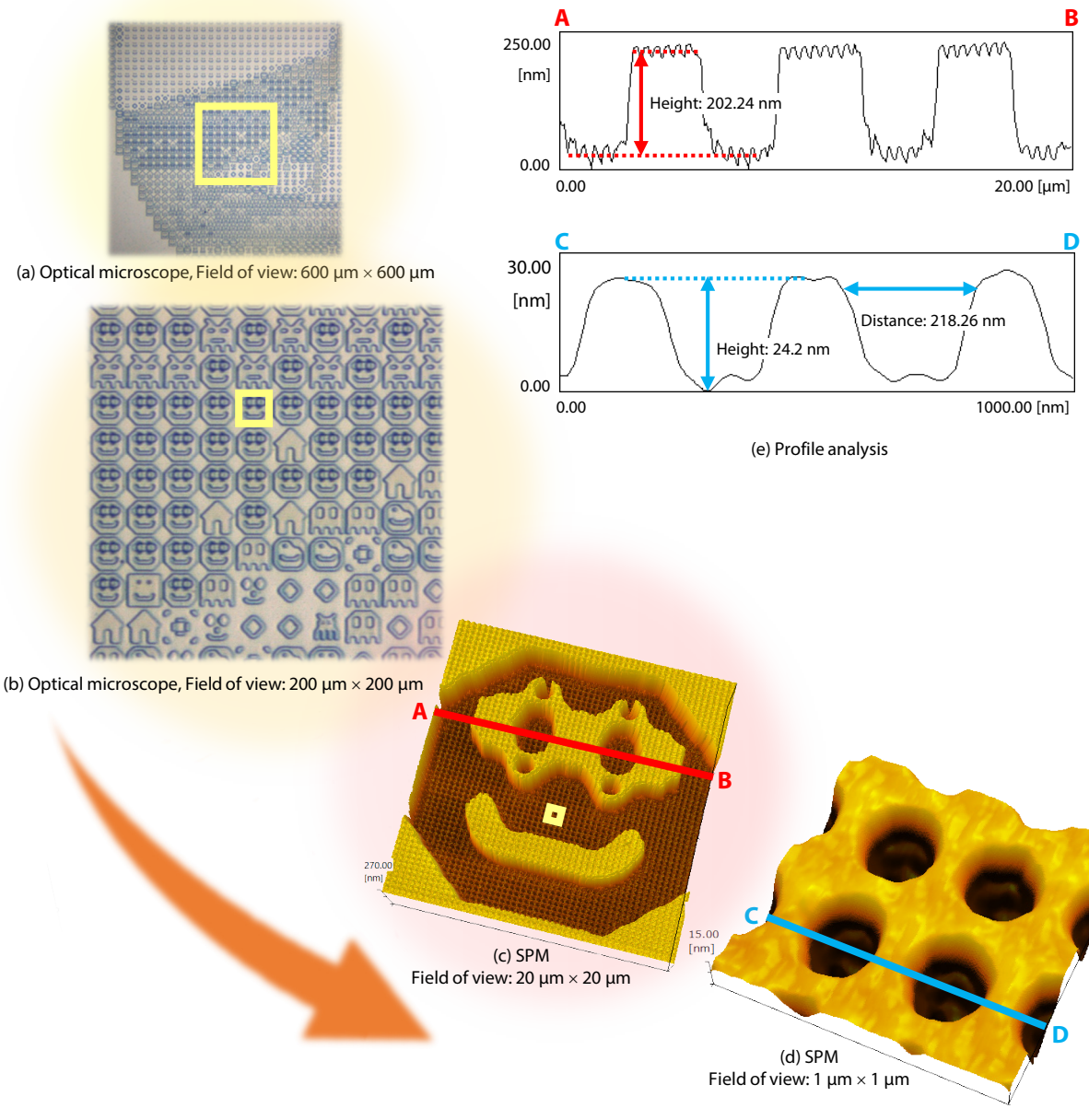


Fig. 3 Surface Topography Images of Patterned Si Substrate Observed by Optical Microscope and SPM

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