

High-Resolution and True 3D Measurements of High-Aspect-Ratio Surface Structures on a Butterfly Wing Using the AFM

SHEET No. 028

SAEMic.
Scanning Atomic and Electron Microscopy

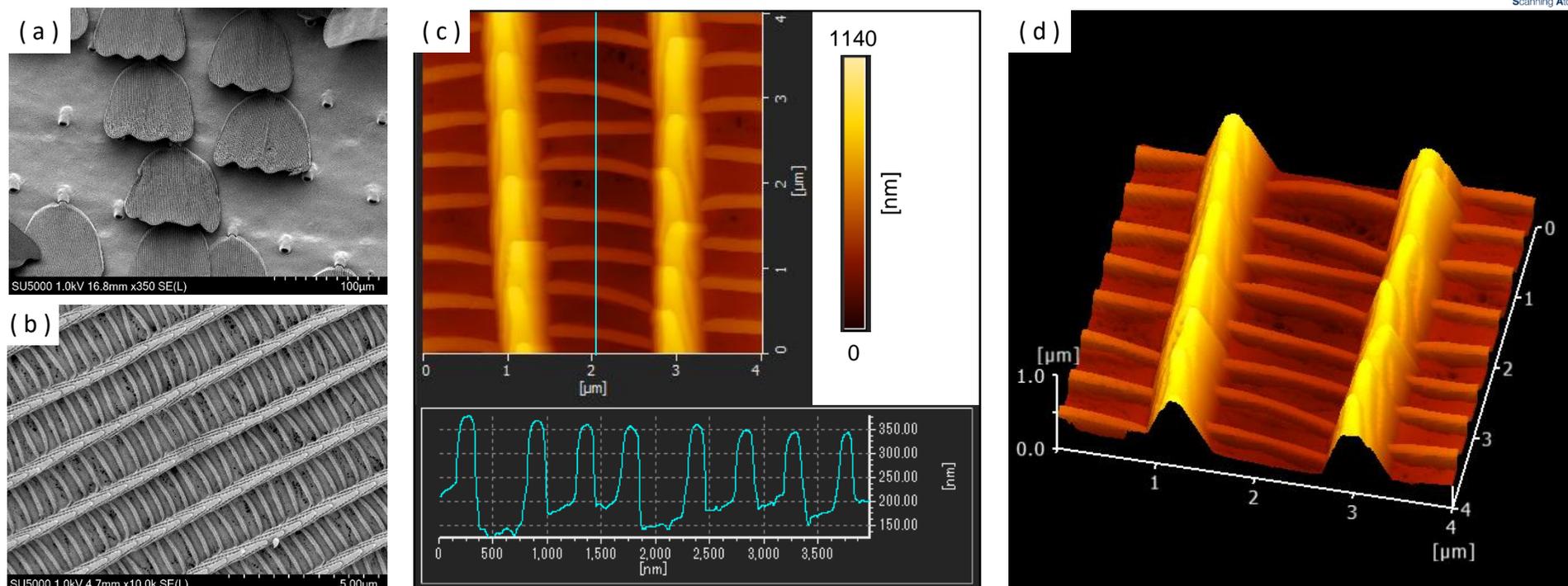


Figure 1. SEM and AFM imaging of the wing scale of a monarch butterfly (*Danaus plexippus*)

(a) SEM SE image of the butterfly wing. (b) High-magnification SE image of the scale surface. (c) Topography image and cross-section profile of the scale surface using the AFM. (d) 3D display of AFM topography image of the scale surface.

Biomimetics is the imitation of superior models, functions, or mechanisms in living organisms. It has attracted a great amount of attention and has been introduced to the manufacturing industry recently. Therefore, accurate 3D measurements of the surface structures are required. In this regard, AFM is a very useful tool for biomimetics at nanometer scale since it can render direct 3D measurements at a sub-nm resolution. Figure 1 shows SEM and AFM images of microstructure on a monarch butterfly wing that was bred in a laboratory for long periods of time. Firstly, we observed the overview of the butterfly wing surface using the SEM. Secondly, we measured the 3D structure accurately using the AFM. Due to the fact that living organisms typically have very soft and high-aspect-ratio surface features, Hitachi-proprietary SIS (Sampling Intelligent Scan) mode with a special high-aspect-ratio tip was used. It allows for an excellent and stable tracking of the surface without any undesired deformation and scratching to the surface. Furthermore, AFM is capable of exploring many of other physical properties, such as mechanical properties for analysis of detailed living organisms' functions.

Sample courtesy of Jiangiu Liu and Kazuei Mita, Biological Science Research Center, Southwest University, China

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3D measurement for high-aspect-ratio microstructure of a butterfly wing using the AFM

Recommended Configuration	Remarks
Scanning Probe Microscope AFM5500M	
• SIS-DFM	
• Cantilever: SI-DF40H	
• Linkage System (AFM, SEM)	
Schottky Field Emission Scanning Electron Microscope SU5000	



AFM5500M



SU5000