

Micron scale insect anatomy

Executive Summary -- The samples imaged were air-dried insects (ant, fruit fly, mosquito) and a tick (Arachnids). A number of structures were imaged to create a single classroom presentation in insect anatomy for North Shore Community College in Massachusetts, and as part of a broader series of classroom presentations directed at grades 9-12, physics, chemistry and biology, at Newburyport High School. The specimens were collected from readily available and indigenous species such as the tick, fruit fly, ant and mosquito. The images showed the students not only specific anatomical detail and inter specie variations but how detailed and complex these structures can be at very small scale.

Sample information

The insects imaged were the tick, fruit fly, ant and mosquito. These were chosen based on their availability, ease of sample preparation, and size (e.g. a grass-hopper or praying mantis are too large to put into the SEM without breaking them apart). Apart from ordering live drosophila (www.wardsci.com, part number #87 V 6550) the insects were collected by 'field work'.

Sample Preparation

The samples were prepared as follows:

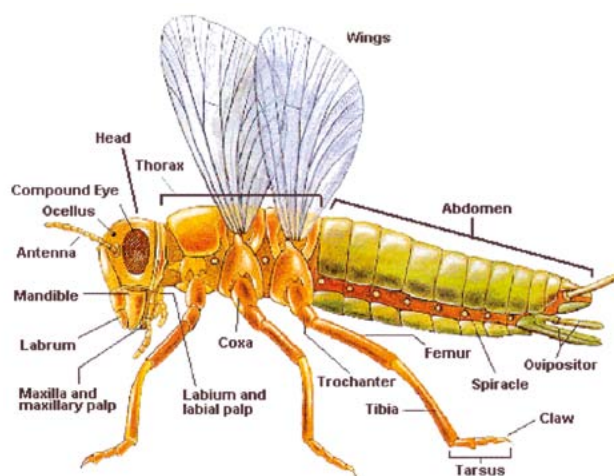
- Collect dead insects or in the case of live drosophila, mortally anesthetize with a cotton ball soaked in acetone or fingernail polish remover.
- Attach to stub using carbon paint.
- Where possible, several samples were of the same insect were attached to a single stub in different body orientations; e.g. lying on the front or side or back.
- Sputter coat with gold.

Imaging

Imaging was performed using a desktop SEM, the Phenom™. The microscope is very easy to use via a touch screen and no special training is needed to operate the system. The user interface has the simplicity of a digital camera.

Comparison and preparation techniques

Images of uncoated insects have been obtained in the SEM; however the coated images have better resolution and more uniform contrast to brightness ratio.



Cartoon of insect anatomy for reference purpose

Conclusions

The image quality and resolution of the Phenom were sufficient to show micron scale features of insect anatomy. The sample preparation was minimal and easy. The dried and coated samples are robust with respect to long term (2 months+) air storage. Insects are particularly 'fun' to use in a live SEM classroom presentation as navigation around the insect is intuitive and interesting, and the entire sample can be easily fit inside the Phenom.

Success and recommendations

This project was deemed a success by the author because of ease of sample preparation, speed of data produced, and quality of images produced to demonstrate micron scale insect anatomy. The recommendation was that it is very useful to have an off line program that stitches multiple images into a single panorama image. The single composite image of the tick was created using such an offline auto stitching software program from the University of British Columbia UBC.

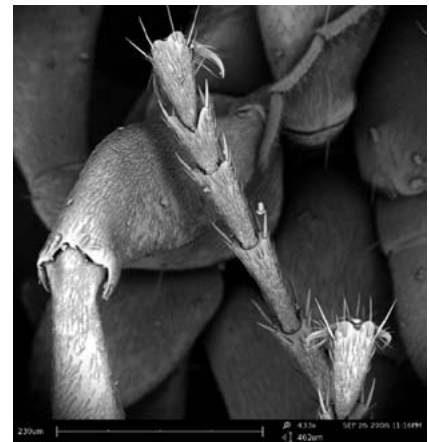
Image Gallery



Ant Mandible:
462 µm FOV.



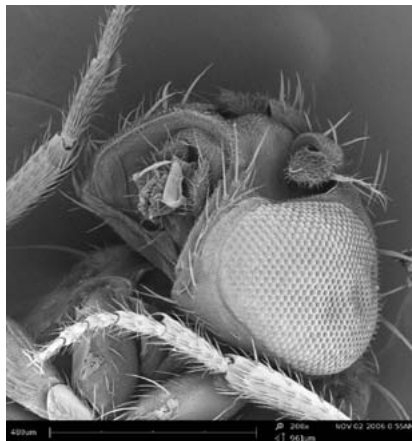
Ant Mandible, inverted:
462 µm FOV.



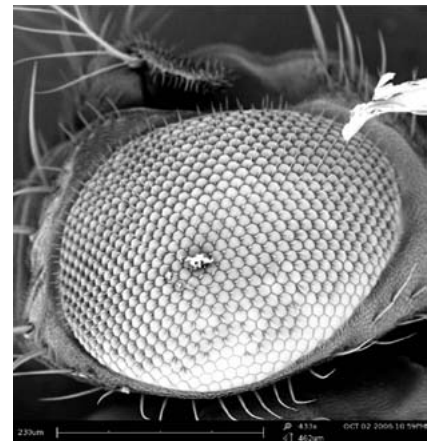
Ant Tarsus and Claw:
462 µm FOV.



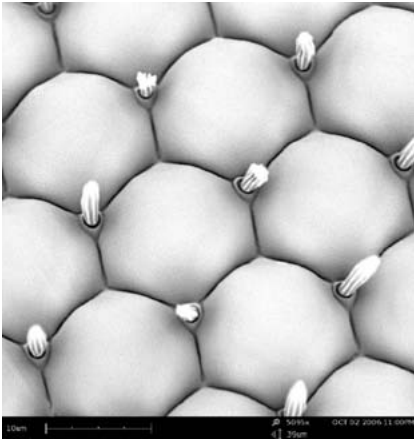
Ant Leg Joint:
110 µm FOV.



Ant Tarsus and Claw:
462 µm FOV.



Fruit Fly Compound Eye:
462 µm FOV.



Fruit Fly Compound Eye:
39 μm FOV.



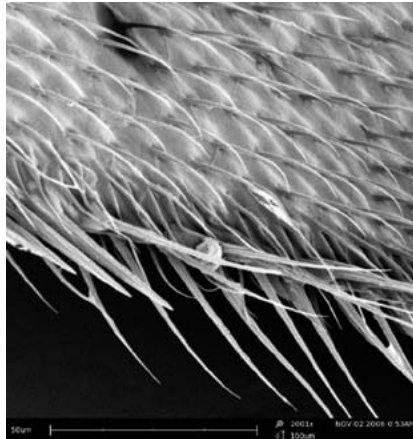
Fruit Fly Ocelli (simple eye):
567 μm FOV.



Fruit Fly Tarsus and Claw:
101 μm FOV.



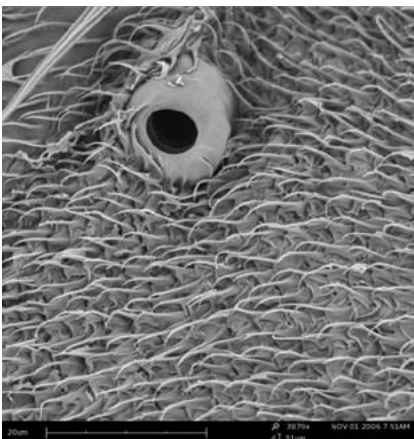
Fruit Fly Wing:
1.2 mm FOV.



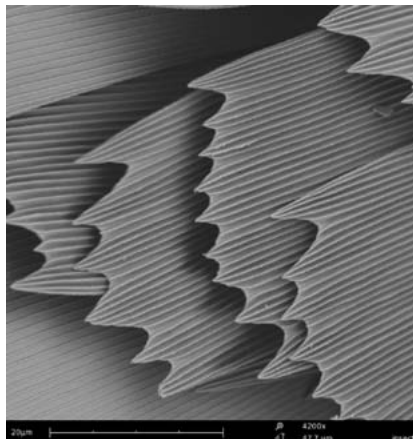
Fruit Fly Wing:
100 μm FOV.



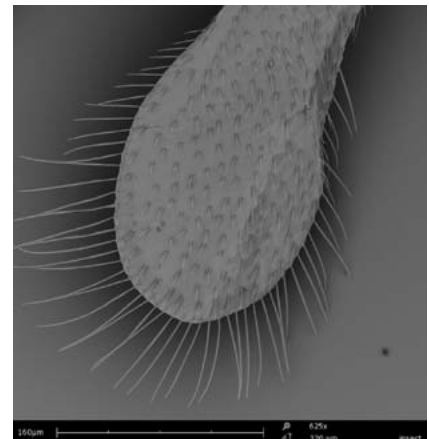
Fruit Fly abdomen with spiracles: 462 μm FOV.



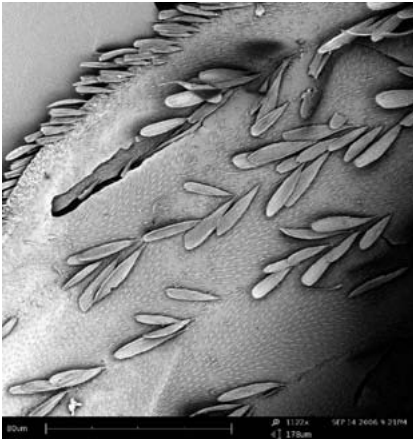
Fruit Fly spiracle:
51 μm FOV.



Butterfly wing:
48 μm FOV.



Wing wasp:
320 μm FOV.



Mosquito Wing:
179 μ m FOV.



Tick spiracle:
1.4 mm FOV.



Mosquito Proboscis:
287 μ m FOV.



Tick, inverted, composite of multiple SEM images.