High-resolution Scanning Electron Microscope —Model HFS-2

Hitachi has developed an ultrahigh-resolution scanning electron microscope for specimen surface observation—Model HFS-2—which offers three times higher resolution as compared to the conventional reflection type scanning electron microscopes.

The two kinds of scanning electron microscopes, which sharply focus the electron beam for specimen observation, are available, the transmission type and the reflection type.

With the transmission type microscope, electrons that have penetrated the specimen are detected. It has superior resolution and is suited for investigation of internal structure of the specimen. Since it penetrates the specimen, however, it is not suitable for surface observation. The reflection type is better for this purpose.

The reflection type microscope indicates on a cathode-ray tube in terms of signals the electrons that are reflected from the surface of the specimen. Therefore, its resolution is said to be inferior to that of the transmission type. Hitherto, surface observation was said to be limited to 100–200 Å. (One Å is 1/100 millionth of one centimeter.)

Hitachi's newly-developed Model HFS-2 can observe minuscule surface construction of 30–50Å. Prof. Keiichi Tanaka of Tottori University used this microscope to successfully photograph for the first time in the world the double spiral structure in the hereditary gene, and Prof. Kenji Takeya of Kyushu University photographed a virus on the surface of a blood cell.

With clarification of the double spiral structure in the hereditary gene, further contributions can be expected in the study of hereditary diseases and cancer cells, and in three-dimensional observation and study of biological structures.

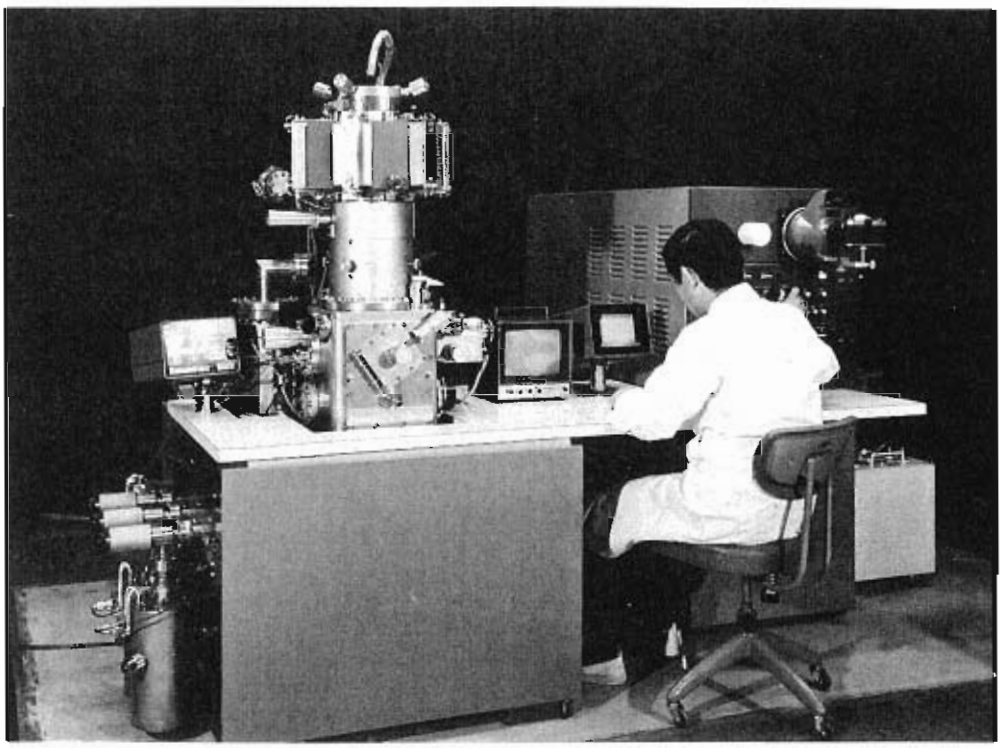
In the past, it was said difficult to obtain high resolution with a scanning electron microscope because a very sharp focusing of the electron beam is required to improve resolution but it caused a drop in the signal current.

Hitachi has succeeded in improving resolution through practical application of a new electron gun based on a completely different theory of field emission in place of the heated electron source.

In field emission, electrons are obtained without generating heat by applying high voltage to small needle-like cathodes. Compared to heat electron cathodes, a beam with density of over 1,000 times is obtained. Furthermore its service life is semi-permanent. The theory of this phenomenon had been known for many years, but its practical application had been considered difficult because of the wide fluctuation of the electron beam.

This new type electron gun has a built-in ion pump, and a super high vacuum with pressure ratio of 1/10,000 millionth is maintained inside the electron gun. Furthermore, a new flushing technique has been developed to sweep away gas elements that become attached to the surface of the cathode. As a result, the electron beam is very clean and stable to obtain high resolution.

The results of research on this scanning electron microscope were announced at a symposium of the International Congress on SEM (ITT) at Chicago held from April 26, and in Japan at the Okayama meeting of the Japan Electron Study Association from May 23, 1972.



Main Features

(1) Higher electron beam intensity can be obtained, which ensures high resolution studies. It permits photographing in a short time.
(2) Repeated photographing is possible because of less specimen contamination.
(3) Fine, detailed structures of biological organisms can be clearly investigated.
(4) Since the filament is a cooled cathode, its life is semipermanent.