

## Development of a New High Throughput 120 kV-TEM

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A new 120 kV transmission electron microscope (TEM) (JEM-1400Plus) has been developed as a multi-purpose, high throughput TEM, especially for biological samples and advanced soft materials. In fact, this is an advanced version of JEM-1400. On this TEM is installed a new image forming system with a bottom mount 8 megapixel CCD camera. In addition to the new image forming system, quite a few appreciable improvements have been introduced to make the original version far more high throughput as well as user friendly and to change it into a completely new TEM.

The new image forming system with a bottom mount CCD camera realizes a magnification of as low as 10 times. At this magnification, a whole area of a sample mesh with a 2mm diameter can be observed in one field of view as shown in Fig. 1(a). The previous image forming system could only attain the magnification of 50 times at the lowest so that only a part of the sample mesh could be observed as shown in Fig. 1(a). To observe the whole area of the sample mesh in that instance, an extra cumbersome and time consuming operation had to be made such as direct observation using a fluorescent screen or inserting a side mount CCD camera. Thanks to the new image forming system we can observe samples in a magnification range from 10 to  $1.2 \times 10^6$  times with one bottom mount CCD camera without the cumbersome and time consuming operation.

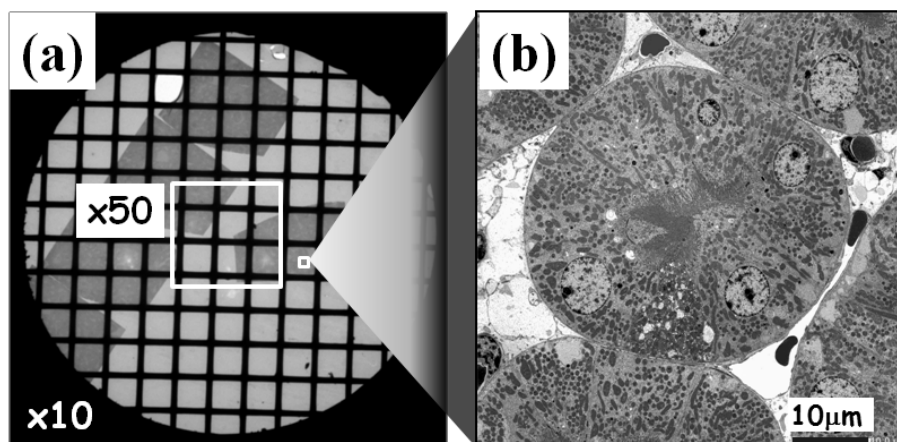
A new function of auto sample driving has been developed. This function enables a sample to move to the position that has been selected and clicked on an image at a low magnification beforehand. With the help of this function, once the field of observation has done at low magnification, the sample can be moved to the desired position without switching the image forming mode (MAG / LOWMAG), which, together with the new image forming system, greatly increases the throughput.

For a bottom mount CCD camera, a CCD with 3296 x 2472 pixels is selected which is large enough for conventional images for biological samples and material specimens. Figures 2(a) and 2(b) show images taken with the previous image forming system with a 1 megapixel CCD camera and the new system with the 8 megapixel CCD camera, respectively. The enlarged images are shown in Figs. 2(a') and 2(b'). The size of pixel in Fig. 2(a) and 2(a') corresponds to  $7 \times 7 \text{ nm}^2$ , whereas that in Figs. 2(b) and 2(b') to  $4 \times 4 \text{ nm}^2$ . The spatial resolution is greatly improved so that the image in Fig. 2(b') is quite satisfactory.

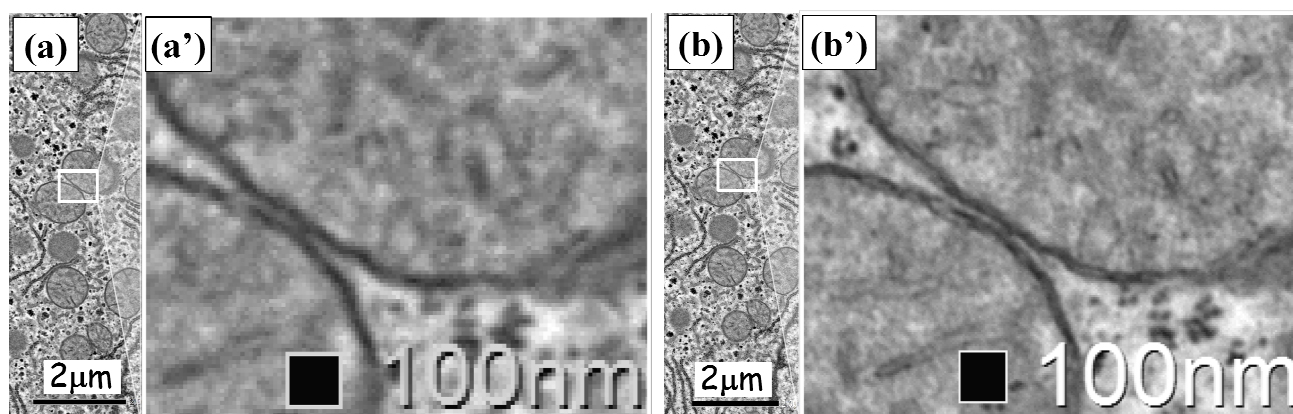
One other characteristic is that the new CCD camera system has been completely integrated with other TEM control system so that the full automated montage image can be made. By using this function, montage image of high resolution with over 60 megapixels, as shown in Fig. 1(b), can be obtained without much difficulty.

Figure 3 shows new operation panels with purpose-changeable organic EL buttons. The number of fixed buttons and knobs has substantially been reduced for the simplification of the panels as indicator. Each individual user, however, can select and revive his or her necessary, removed functions from the fixed buttons and knobs and assign them to the EL buttons one by one so that the desired numbers of the EL buttons are customized.

We are certain that this new high throughput TEM is widely accepted by less experienced as well as highly experienced users.



**Fig. 1.** The images of mouse kidney taken at 120 kV. They were taken with a new image forming system with a bottom mount CCD camera. (a) shows an image of a whole area of a sample mesh at an ultra low magnification of 10x. A field of view at 50x is superimposed on the image. (b) shows the 5 x 5 montage image of the area shown in (a) as small square taken at 1000x.



**Fig. 2.** The images of rat hepatic cells taken at 120 kV. (a) and (a'), and (b) and (b'), show images taken with a previous 1 megapixel and a new 8 megapixel CCD camera, respectively.



**Fig. 3.** Outer view of new operation panels. The number of fixed buttons and knobs has substantially been reduced for the simplification. About fifty functions for organic EL buttons are, however, prepared for the functions deliberately selected by an individual user.