

MICROPROCESSOR CONTROL OF A FIELD EMISSION SCANNING ELECTRON
MICROSCOPE (MODEL S-800)

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We have developed an ultra high resolution scanning electron microscope utilizing a field emission electron source. (Fig. 1) This instrument has a guaranteed resolution of 2 nm in the secondary electron image mode and it has incorporated a microprocessor control for optimized operating conditions and maximum ease of operation by various automated functions. The microprocessor control system includes ① field emission electron gun control, ② electron optical system control, and ③ video signal control. The field emission electron gun control system includes flashing operation which is used to clean the tip surface by heating for a very short time, high voltage operation of accelerating voltage (V_0) and tip voltage (V_1), correction of emission current which changes with time, and correction of virtual source position which changes with a voltage ratio V_0/V_1 . We have automated these series of operations by developing an auto FE gun control system. Fig. 2 shows details of this system. When the operator activates a start switch, the microprocessor checks vacuum conditions, turns on the tip flashing, and applies accelerating voltage (V_0) and the tip voltage (V_1). It also regulates emission current and presents image on the CRT screen within 10 seconds after the start switch is turned on.

For an electron optical system control, the microprocessor computes virtual source position which is determined by the electro-static lens effect of the field emission gun and controls electron optical lens system for optimum probe current and focus conditions. (Fig. 3)

For a video signal control, the super autofocus system has been developed. (Fig. 4) It processes secondary electron signal emitted from the specimen for just focused images. The system differentiates the video signal and integrates it in such a manner as to regulate focusing lens current quickly and precisely until a good focus condition is achieved. This system operates effectively at a high magnification range of a few tens of thousand times.



Fig. 1 Model S-800 scanning electron microscope

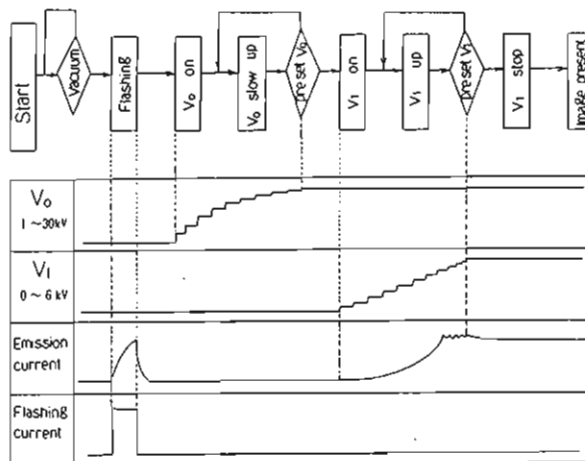


Fig. 2 Automatic FE gun control

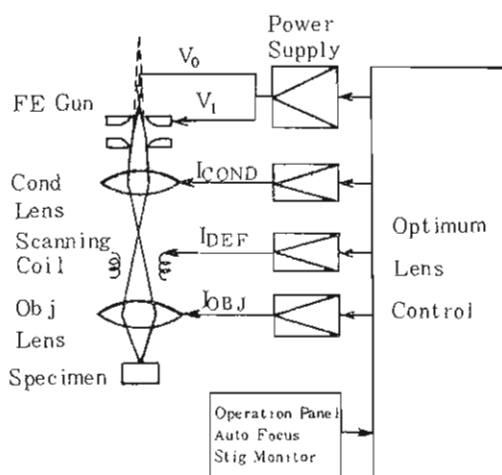


Fig. 3 Optimum lens system control

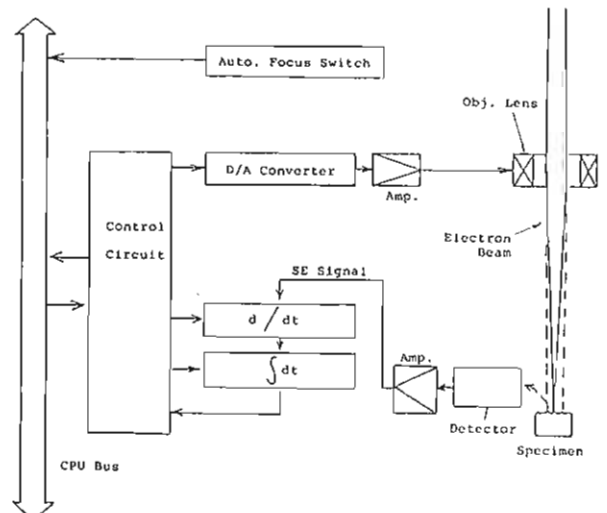


Fig. 4 Super Auto-Focus System