NU Tech
Technology Partnership of Nagoya University, Inc.

(E-12)

# Reforming of Observation (Microstructure) and Creating (Microfabrication) by Photoelectron Beam

## Technology Overview

The photoelectron beam is a technology that produces an electron beam from a cathode by irradiating the cathode with a laser beam. By adopting semiconductor material as the cathode, Nagoya University researchers have developed a low-cost and simpler system than previously existing technology, which can be incorporated in a variety of industrial equipment (Figure 1).

This technology can realize dynamic observation at the nano-level, which is conventionally impossible; as well as making dramatic high throughput microfabrication possible. It gives a breakthrough to a wide range of fields such as life-sciences, materials, and electronics, etc. by renovating the electron beam as a key device of industrial equipment such as electron microscopes, semiconductor device manufacturing and inspection equipment, and metal 3D printers.

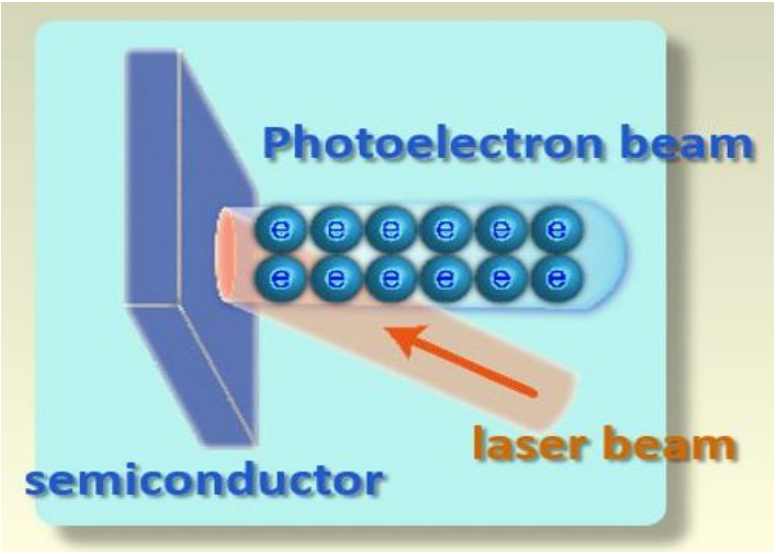
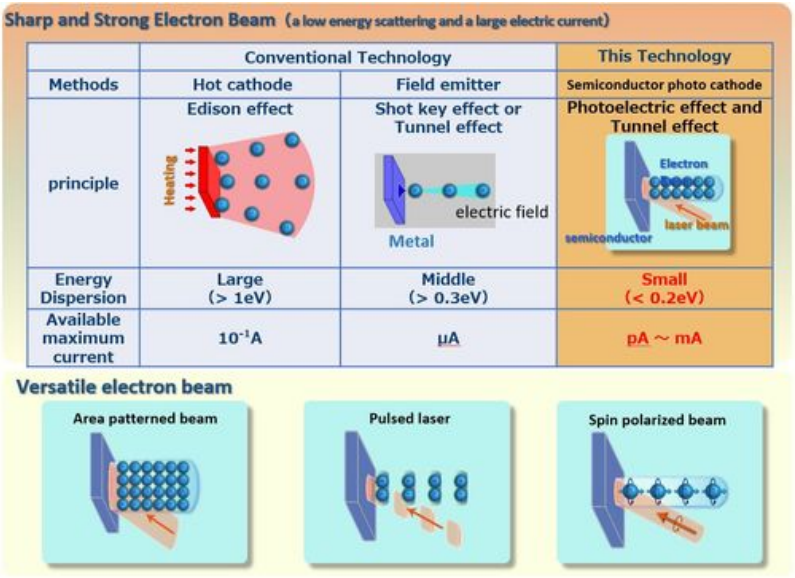



Figure 1: Photoelectron beam technology developed by Nagoya researchers

## Benefits

Fig2. The benefits of this technology are outlined




## Contact

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**Applications:**

In-situ nanoscale observation (application to electron microscope) - Conventionally, detailed dynamic observation was difficult because of the movement of the sample. This technology allows sub-millisecond imaging. It works well in the dynamic observation in an aqueous solution, or sample in a gas atmosphere chamber (Figure 3).

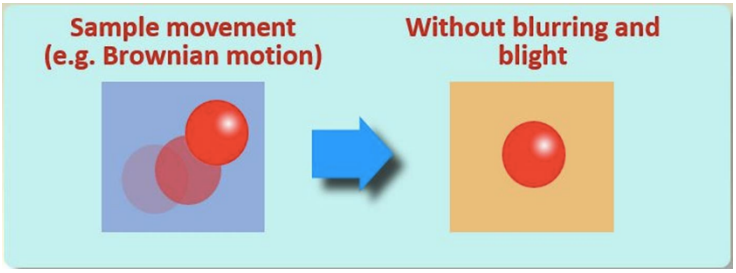


Figure 3: Application to electron microscope (in-situ nanoscale observation)

3D Structure Analysis of Proteins (application to cryo-electron microscope) - Traditionally, waiting time for imaging in minutes was required. With this technology, sub-millisecond imaging can be achieved (Fig. 4)

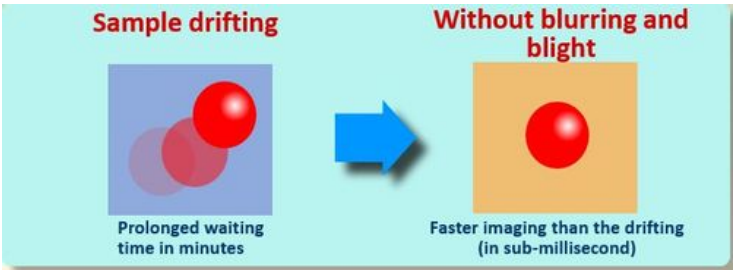


Figure 4: Application to cryo-electron microscope

Observation of Soft Materials (application for electron microscopy) - Conventionally, imaging causes sample damage from taking a long time of electron beam irradiation exposure to get a sufficient amount of light. With this technology, imaging with the amount of irradiation that does not break the sample was enabled by using a single beam lasting milliseconds or less. It works well in observing the samples that are sensitive to an electron beam (Figure 5).

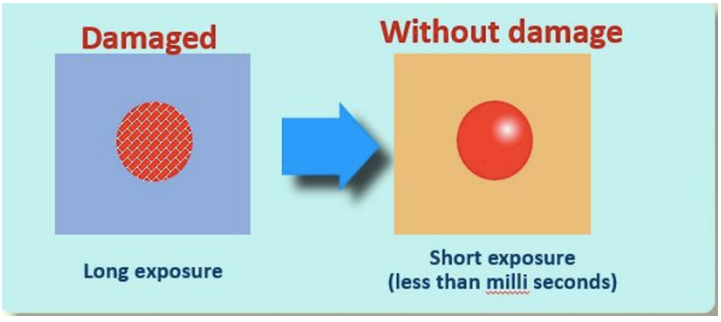


Figure 5: Application to electron microscope (observation for soft materials)

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## Application for Cathode Luminescence:

1. Time-resolved CL - Time-resolved CL measurement by pulsed laser -> evaluation of crystalline defects or impurities on semiconductor materials
2. Fine-tuning of current density (nA -10 microA) - By changing the strength of laser beam, the current density will be controllable -> this can be used to conduct measurement of a wide bandgap semiconductor

## State of Development:

- Photoelectron beam - continuous beam, pulsed beams, multi beam
- Photo cathode - II-V group semiconductor
- Easy to move - 500 mm (H), 70 kg

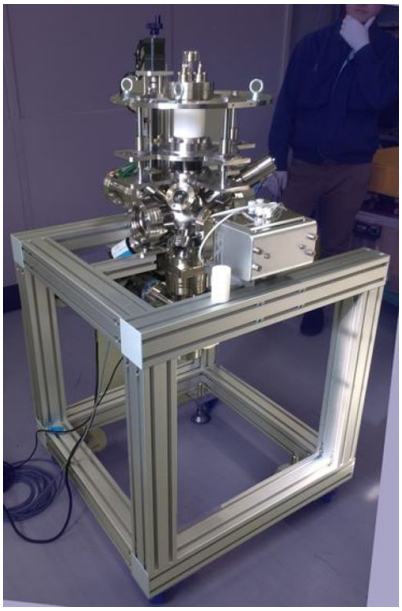

Figure 6. A prototype of the Photoelectron Beam Generation System has been constructed:

## Seeking

Licensing

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