

## Study of massive parallel direct electron beam delineation systems

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### 【Outline of survey】

The purpose of the research is to develop high throughput mask less electron beam delineation systems needed for small volume production and short term development in integrated circuit manufacturing. "Massive Parallel Electron Beam Lithography Systems" which has many parallel electron beam optics have been developed based on micromachining technology which is an extended microfabrication for integrated circuit. The electron beam from a small size electron source using carbon nanotube field emitter is focused by a single electrostatic lens. Patterns are delineated in parallel by blanking multiple beams and by scanning a wafer stage. The scanning stage, the glass which has feedthrough to make electrical interconnection to the control circuits and other components are developed for the system.

Shottkey emitter made of diamond are also developed. Basic research to grow a single carbon nanotube at an apex with high yield are also carried out. "Massive Parallel Electron Beam Lithography Systems" are expected to be developed by extending these research activities.

### 【Expected results】

Mass production is established using photomasks in the LSI business but the cost for the mask is too high especially in advanced LSI. For this reason maskless exposure is expected for small volume production and short term development. However extremely high throughput is required for practical electron beam exposure systems and for this reason massive parallel electron delineation system is being developed.

### 【References by the principal investigator】

- P.N.Minh, T.Ono, N.Sato, H.Mimura and M.Esashi, Micro Electron Field Emitter Array with Focus Lenses for Multi-Electron Beam Lithography, Digest of Technical Papers, Transducers'03, Boston (2003 June 9-12) 1295-1298

【Term of project】 FY2007—2011

【Budget allocation】 27,000,000 yen

(2007 direct cost)

【Homepage address】

[http://www.mems.mech.tohoku.ac.jp/index\\_e.html](http://www.mems.mech.tohoku.ac.jp/index_e.html)