[III~15] [초청]

LASER FABRICATION OF MICROCOLUMNS FOR FOCUSED ELECTRON OR ION BEAM GENERATION

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Ultraminiature field emitter arrays fabricated with advanced microfabrication technology have been intensively studied as promising electron sources for vacuum electronic devices, specially for flat-panel display and micro- scanning electron microscope fabrications.

For this purposes it is perfectly possible to weld, cut and drill similtaneously in one chamber by laser radiation. Lasers do offer a number of advantages over other conventional techniques such as:

- laser radiation is very "clean" form energy.
- laser beam may be focused onto very small micron-size areas because of their great spatial and temporal coherence. The intensity of local heating can take place without neighboring areas being affected.
- it is easy and precisely to control the beam parameter irrradiance.

If the laser -beam irradiance is such that the temperature of the material reaches its boiling point, then significant amount of the surface material will be removed. The rate of removal depends upon the parameters of laser beam; pulse duration, energy of beam, density intensity per cm^2, etc) and upon the proporties of materials; thermal conductivity, thermal diffusity, melting and boiling points and latent heat of vaporization.

The focused sport size of laser beam depends of the quality and stability of laser and for gaussian TEM_{00} beam is given by:

$$r_s = \lambda^* f / \pi^* \omega_L$$

Here : ω_L is the beam radius at the final focusing lens, r_s is focused radius beam, λ is wavelength of the beam, f is focal length

We have pulse TEM_{00} YAG:Nd^{3+} laser setup with following parameters:

wavelength	energy	pulse duration	pulses per second	
1064 nm	0 - 1 J	100 or 200 mks	0 - 25 Hz	
1064 nm	0-200mJ	10 - 20 ns	0 - 25 Hz	
532 nm	0-100mJ	10- 20 ns	0 - 25 Hz	
532 nm	0-50 mJ	200 mks	0 - 25 Hz	
355 nm	0-30 mJ	10 - 20 ns	0 - 25 Hz	
266 nm	0-20 mJ	10 ns	0 - 25 Hz	

Using this laser setup we can make holes on semiconducting materials like Si or metallic molybdenum, tantalum and other materials.

We can achieved good quality of holes with diameter severlal microns in the above mentioned matireals. The quality and parameters of holes are presented in Figures 1-5. The focused electron beam has a capability of a microsize spot at a working distance of a submicron size spot using laser-fabricated micro-columns.

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