

X-ray Generation Experiments using Sinmyung Laser Facility in KAIST

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Progresses in short (≤ 1 ns) and ultrashort (≤ 1 ps) high-peak-power laser technology have made it possible to produce plasmas with short durations of x-ray emission. Detailed studies on the characteristics of laser-plasma and emitted x-ray have been performed for laser pulse durations in nanosecond range because of the world-wide interest in the inertial confinement fusion. Investigations on laser-plasma and x-ray generation with picosecond and subpicosecond laser pulses are actively under progress in many countries.

Korea Advanced Institute of Science and Technology completed development of a one beam Nd³⁺:glass laser facility named as Sinmyung capable of delivering 80 J in 40 ps (FWHM) pulse at system firing rates of 6 shots/hr.[1] In this facility, we used a Nd³⁺:YLF laser as a master oscillator, a 4-pass amplifier[2] for pre-amplification, 5-stage of rod amplifiers, and spatial filtering and image relaying units. Figure 1 shows schematic diagram of the laser system.

With this facility a preliminary laser-plasma and x-ray generation experiments were performed. Pinhole images, x-ray diode signals and x-ray spectrum were obtained for irradiated target of copper (Cu).

To find optimal position of focusing lens and to determine sizes of generated plasma, a pinhole camera was used. Figure 2 shows two pinhole images which were obtained at two positions of the focusing lens. When optimal focusing condition of laser beam onto target surface was achieved, the focal spot diameter was approximately 100 - 200 μm depending on laser output energy.

An x-ray diode was used to provide x-ray intensity measurements with pseudo-temporal resolution. Figure 3 shows a typical oscillogram of an infrared diode signal for laser pulse and the x-ray diode signal for generated x-ray. The signals were recorded by a 500 MHz digital oscilloscope (HP 54520A).

A flat crystal spectrometer with a mica crystal was used to obtain x-ray spectra. A densitometer trace of a x-ray spectrum in the wavelength region of 11 - 13 \AA is shown in Fig. 4. The dominant spectral lines are those from Ne-like CuXX ions.

We constructed a Nd³⁺:glass laser facility (Sinmyung) capable of delivering 80 J in 40 ps (FWHM) pulse at system firing rates of 6 shots/hr. A preliminary laser-plasma and x-ray generation experiments were performed with the facility. Pinhole images, x-ray diode signals and x-ray spectrum were obtained for irradiated target of Cu. Studies on laser-plasma and x-ray emission characteristics are actively under progress.

References

- [1] Hong Jin Kong, Sang Soo Lee, Ki Gwan Han, Nam Seong Kim, Hyun Soo Kim, Ki Young Um, Jong Rak Park, and Jae Yong Lee, *Inst. Phys. Conf. Ser. No 140 : Section 9, 321 (1995)*
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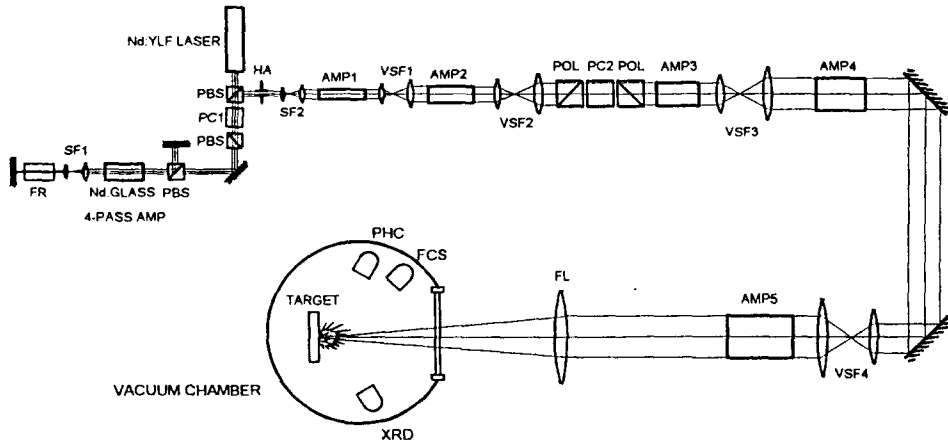


Fig.1. Schematic diagram of Sinmyung I system
 PBS : Polarizing Beam Splitter, PC : Pockels Cell, FR : Faraday Rotator,
 HA : Hard Aperture, SF : Spatial Filter, AMP : Amplifier,
 VSF : Vacuum Spatial Filter, POL : Polarizer, FL : Focusing Lens,
 PHC : Pinhole Camera, FCS : Flat Crystal Spectrometer, XRD : X-ray Diode

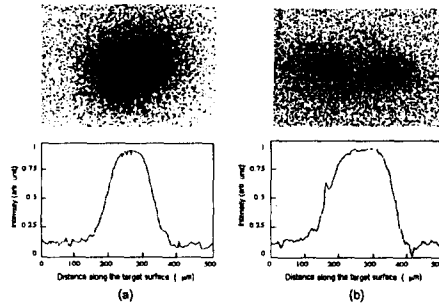


Fig.2. Two pinhole images which were obtained at two positions of the focusing lens; (a) the focusing lens was at optimal position; (b) the focusing lens was located at 5 mm nearer to the target. The densitometer traces are placed below the images.

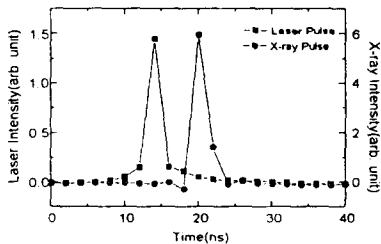


Fig.3. Oscillogram of the infrared diode and the X-ray diode signals

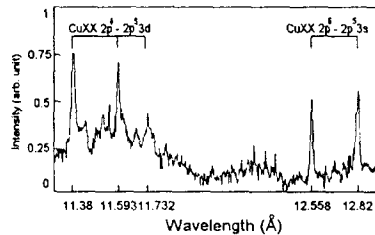


Fig.4. Densitometer trace of a spectrum with the line emissions of Ne-like CuXX ions