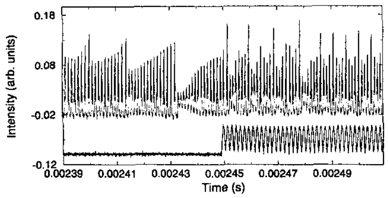
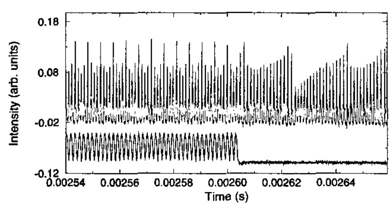


QWD9 Fig. 1. Experimental time trace of intensity vs time. Lower trace is the pump which is modulated. The modulation strength is 20%. The Upper trace is the response of the ammonia laser. Period 4 pulsations occurs after some initial transient behaviour.



QWD9 Fig. 2. Continuation of Fig. 1 showing the restoration of chaos after the modulation is turned off.

second threshold, and the modulation frequency is restricted to near the fundamental instability frequency. This means that the mechanism is not a delayed bifurcation,[1,2] but rather a form of chaotic resonance. This form of control is the replacement of chaos by regular periodic pulsations. Shifting the pump modulation frequency destroys one of the stable periods, but allows a signal with a different period to emerge if the pump modulation frequency is shifted an appropriate small amount. If shifted too far then control is lost. Comparisons have been made with numerical simulations and we have found the results are in reasonable agreement.

Figure 1 is an experimental time trace which shows before modulation the laser output is chaotic. When the modulation is applied, there is at first a non-periodic transient. Then the trajectory in phase space settles on a limit cycle created by the pump modulation, and results in period-4 pulsations in the laser output. Figure 2 shows that when the modulation is removed chaotic dynamics reasserts itself.

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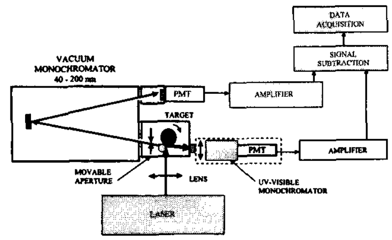
QWD10

XUV spectroscopy of laser plasma from molecular coated metal targets

V.O. Papanyan, G.Ts. Nersisyan, F.K. Tittel,* *Institute for Physical Research, Armenian National Academy of Sciences, Ashtarak-2, 378410, Armenia; E-mail: root@ipr.arminco.com*

It was recently recognized that a structured solid target can provide increased coupling of intense laser pulses and produce a high-density plasma medium that is suitable for a high-intensity XUV source and for recombination pumped soft X-ray lasers.[1,2] Metal targets (tungsten, aluminum or carbon) covered by micrometer thick layers of metal-phthalocyanines[3] or fullerenes are studied in this report. An increase in XUV yield due to specific intracluster processes that occur in an intense field will be reported. Metal ions encaged at the center of phthalocyanine molecules can produce effectively multi-charge ions in the laser field due to a high intramolecular electron density, free electron effective formation and heating. Effects of cluster formation in high-temperature plasma during its rapid expansion are under detailed investigation. (An expansion velocity about 10^6 cm/s has been observed.)



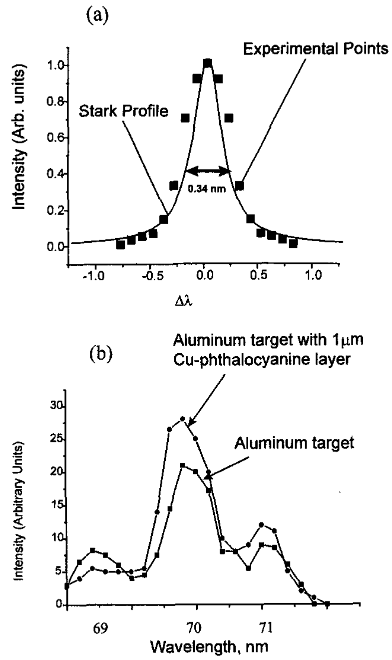
QWD10 Fig. 1. Schematic of experimental setup.

The experimental setup (Fig. 1) consists of a vacuum monochromator enclosure, visible-UV-monochromator, solid-state laser, target chamber, and detection and data acquisition system. Moderate power nanosecond and picosecond neodymium lasers are used to produce an incident intensity of 10^{11} to 10^{13} W/cm^2 on the targets. The vacuum monochromator with a 1 m radius concave grating, equipped with a differential vacuum pumping system is used to obtain spectra in a region from 40 to 300 nm with a resolution of less than 0.05 nm. The rotatable cylindrical target is mounted with its axis parallel to the monochromator slit. The plasma expansion is characterized with the help of a moving aperture in front of the entrance slit.

The plasma electron density is measured by fitting the observed spectral profiles to the Stark broadening profile [Fig. 2(a)]. In particular, the Al^{3+} at 76.8 nm, Al^{2+} at 56 nm, Al^{+} at 247.5 and 263.2 nm, C^{3+} at 253 nm, C^{2+} at 229.7 nm lines were analyzed. Collisional, Doppler, and Stark broadening mechanisms are taken into consideration. This measurement technique permits us to determine the electron density and temperature dependence on distances from the target surface from 1 mm (e.g., for an aluminum plasma $N_e = 2.0$ (± 0.5) 10^{18} cm^{-3} and T_e = 14 eV) up to ~5 mm (where $N_e \geq 10^{17}$ cm^{-3}). The variation of N_e as a function of distance follows approximately a z^{-1} law, so that a plume expansion model can be applied.

Electron temperature was measured by comparing intensities of spectral line pairs, belonging to ions with a different degree of ionization. Mechanisms responsible for the clustered plasma ionization build-up and electron heating will be discussed.

Preliminary experiments show that conversion efficiencies for molecular coated targets are greater by a factor of 1.5–2 than those measured from bulk solid metal targets [Fig. 2(a)]. Different types of molecular coatings are currently being investigated.



QWD10 Fig. 2. Spectral profiles of (a) the 237.3 nm Al line, the profile fit (width of 0.42 nm) is a convolution of Stark (0.34 nm width) and instrumental profiles, and (b) of the 69.95 nm Al line with and without the Cu-phthalocyanine coating.

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**Department of Electrical and Computer Engineering, Rice University, MS 366, 6100 Main Street, Houston, Texas 77251-1892 USA; E-mail: fkt@ece.rice.edu*

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QWD11

High-intensity, far-field transverse effects in a 532-nm, nanosecond laser beam as a result of nonlinear interaction with nematics

Svetlana G. Lukishova,* *Liquid Crystal Institute, Kent State University, Kent, Ohio 44242 USA; E-mail: svetlana@cpip.kent.edu*

Nematic liquid crystals (LCs) have remarkable peculiarity in laser beams: the same material may totally change its response to laser radiation owing to special preparation and/or the geometry of irradiation. They may be used for optical power limiting[1] and, on the other hand,