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Investigation on the spatial evolution of the emission spectra in laser-induced Ni plasmas

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Abstract. The spatial resolved emission spectrum of Ni atom in laser induced Ni plasma is measured in the wavelength region from 350 nm to 600 nm. The spatial evolution of the relative intensities and the Stark broadening of the 385.83 nm emission spectrum lines are also obtained. It is shown that Stark broadening and intensity of the spectrum lines increases firstly to its maximum and then decreases along the direction of laser beam when the distance from the target surface is in the range from 0 to 2.5 mm. The maximum value of Stark broadening and relative intensity of the spectrum lines appear at 1.5 mm from the target surface.

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Key words: laser induced Ni plasma, emission spectra, the spatial resolved emission spectrum, Stark broadening

1 Introduction

In the many researching means, the diagnosis technology of plasma emission spectra is widely used with its simply operation and without interference characters for the plasma. People have given a lot of information about the plasma with this technology, such as the mechanism of plasma generation(including the process of breakdown, the laser indignation combustion and detonation) and its thermodynamic characters(electronic density, the stimulate temperature and the macro expansion and so on)[1,2]. It can obtain the different compositions and the evolution features of the state in the plasma with the measured time and spatial resolved spectra, can help the people to understand the formation and expanding rule of plasma plume and reflect the state change of the excited atom and

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ions. It is especially important for us to understand the physical and chemical characters of the ablation process, also is the most concerned content in the material vapor deposition. Although there have many reports about the research of the laser induced plasma emission spectra in the literatures [3-19], is basically based on the study of the time evolution emission spectra and is less for the spatial evolution emission spectral. Ma *et al.* studied the interaction of the aluminum plasma plume and argon through the research of the time and spatial resolved emission spectra, the results show that in the plasma center there have plenty of argon and aluminum plasma plume mixed [20]. Zorba *et al.* analyzed the spatial resolved emission spectra using femtosecond laser-induced breakdown spectroscopy and realized the high spatial resolution chemical analysis [21]. We measure the spatial resolved emission spectra of Ni atom in the plasma ablated by the laser, the relative intensity of the emission spectra and the change character of the Stark broadening with the radial distance using the 532nm laser to ablate Ni target.

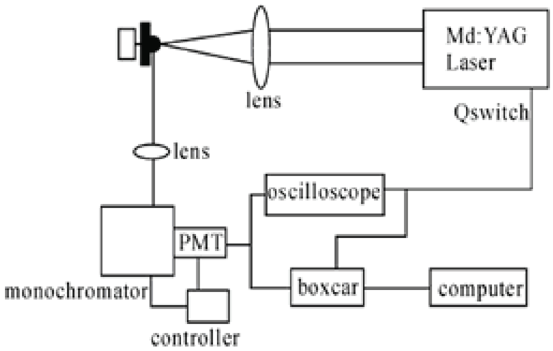

Figure 1: Diagram of the experimental setup.

2 Experimental

A schematic diagram of the experimental set-up is shown in Fig. 1, the laser sources for ablation is 532 nm output of YAG laser(Spectra-Physics, LAB170-10), repetition frequency 10HZ, pulse width 7ns, beam diameter 6 mm, Mono-pulse laser energy (532 nm) in the range of 2-300mJ can be adjusted. The pulse laser beam is focused to the surface of the Ni target using a quartz lens with 100 mm nominal focal length, the focus in the samples from the sample surface is about 2 mm, so you can get the best plasma emission spectra signal. In order to ensure that each laser pulse rips into the different target position, with slow rotation motor (1R/min) controlling samples for low speed rotation. Samples are in the atmospheric environment. In the vertical direction with the laser beam and the parallel direction with samples, the laser plasma emission spectra signal was coupled to the entrance slit of monochromator (ACTON, SP-2750) with the 70 mm focal length lens combination the two times imaging amplification. The imaging lens was placed on one