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EFFECT OF UV AND IR WAVELENGTHS ON PLASMA CHARACTERISTICS FOR FEMTOSECOND LIBS ON COPPER AND STEEL SAMPLES

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Laser induced breakdown spectroscopy (LIBS) is a known method for elemental analysis of various materials, both in-situ and in the laboratory [1]. Using fs pulses for LIBS results in reduced sample damage [2], lower ablation threshold, low continuum emission and better repeatability [3]. An important parameter of LIBS is the wavelength used for plasma generation. The effect of wavelength is thought to be more critical for longer nanosecond pulses, but in the case of fs-LIBS, the laser-matter interaction is different, the pulse duration is much shorter than material heat transfer, plasma forms after the pulse, signifying that there is no shielding of the pulse. However, the dependence on wavelength for fs - LIBS has not been extensively studied.

Femtosecond Yb:KGW laser "Pharos" (Light Conversion Ltd) with pulse duration of 170 fs, 6 kHz repetition rate and up to 6 W of average power was used. Andor Mechelle Spectrograph with an ICCD camera was used to record spectra. The fundamental (1030 nm) and third (343 nm) harmonics were used to determine the effect of source wavelength on LIBS parameters. Energy fluence on the sample was kept constant with both wavelengths. The samples used were O. F. H. C. copper (99.95+% purity) and AISI 301 stainless steel.

Plasma temperature was evaluated at thermal equilibrium using the Boltzmann plot method. 400-800 ns after laser ablation, the plasma temperature was around 9000 K on copper and 8000 K on steel, and there was no difference, within error, between UV and IR wavelengths. Electron density was estimated to be $(1.2 \pm 0.4) \cdot 10^{18}$ cm^{-3} on copper sample and $(1.4 \pm 0.4) \cdot 10^{16}$ cm^{-3} on steel sample, the use of UV and IR wavelengths resulted in equal densities. Signal-to-noise ratio (SNR) was evaluated for both wavelengths and is shown in Fig. 1. Our experiments showed that fs UV-LIBS in copper and stainless steel samples gives higher SNR than fs IR-LIBS at the same energy fluence.

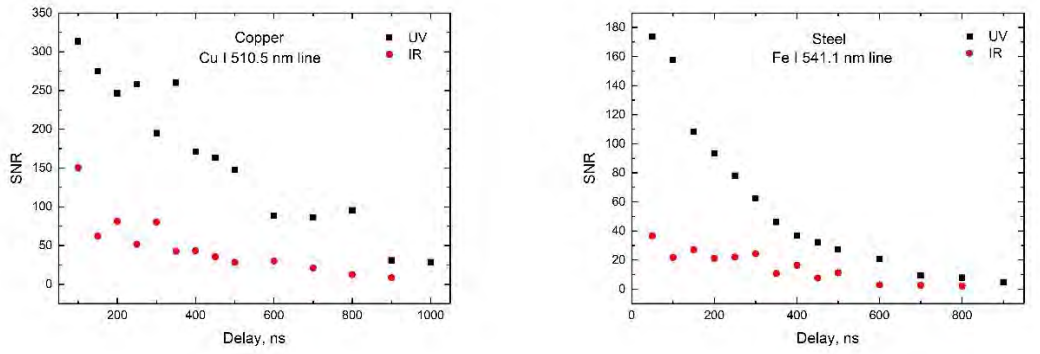

Fig. 1. Comparison of UV and IR LIBS signal to noise ratios of Cu I 510.5 nm (on the left) and Fe I 541.1 nm (on the right) spectral lines.

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