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Scientific works

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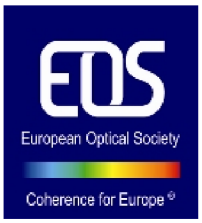

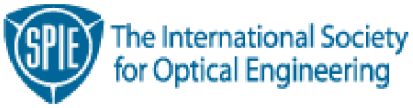

CONTENT

BP.2

RUBY LASER BEAM INTERACTION WITH GLASS

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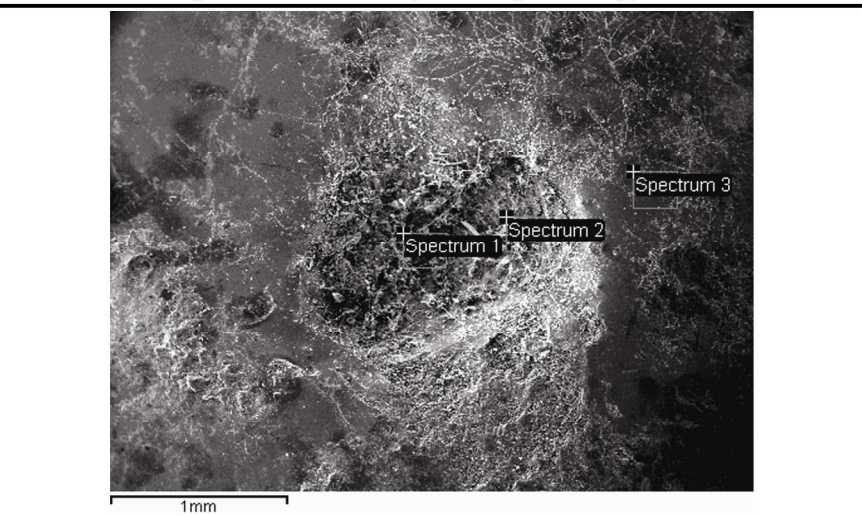
This paper presents the results of the interactions ruby laser light - surface of glass. The investigation was conducted in order to determine the maximum energy density laser light which can be safely applied in the different optical systems. Holographic interferometry, ESPI, shearography, laser tomography and other diagnostic methods use ruby laser light. It is useful therefore to determine the maximum energy density laser light with a wavelength of λ=694.3 nm, which does not cause damage to glass components of systems.

The ruby laser, used in the experiment, was in the TEM00 mode, Q-switch. Pulse length was t = 30 ns. Coherent length lc = 1m. The output beam of light was Φ = 16 10-3m. Output energy was E = 1J with the Gaussian distribution. Energy density DE = 500·103 J/m2. Glass material is utilized as target specimen.

The process of irradiation took place in atmospheric conditions. Laser light has been focused by a lens of f = 0.1m. The interaction of laser beams with materials is a complex phenomenon that depends on many factors; energy density of the laser beam, time of irradiation, or pulse length, wavelength, and distribution of energy within the beam are related to laser characteristics.

The laser-induced damage process is believed to be associated with localized formation of plasma, heating of the material leading to melting and transient stresses that instigate mechanical damage. A damage on the surface of an optical material generated using nanosecond laser sources usually appears as a crater with rough surfaces that strongly scatter the incoming laser beam. Most often cracks originating at the bottom of the damage crater are visible.

The results of laser light interactions were investigated by scanning electron microscope (SEM) with energy-dispersal unit for the analysis of X-ray (EDX) (fig.1). The results obtained by SEM and EDX analysis show that the maximum allowable energy density is around 50·103J/m2 for ruby laser light.



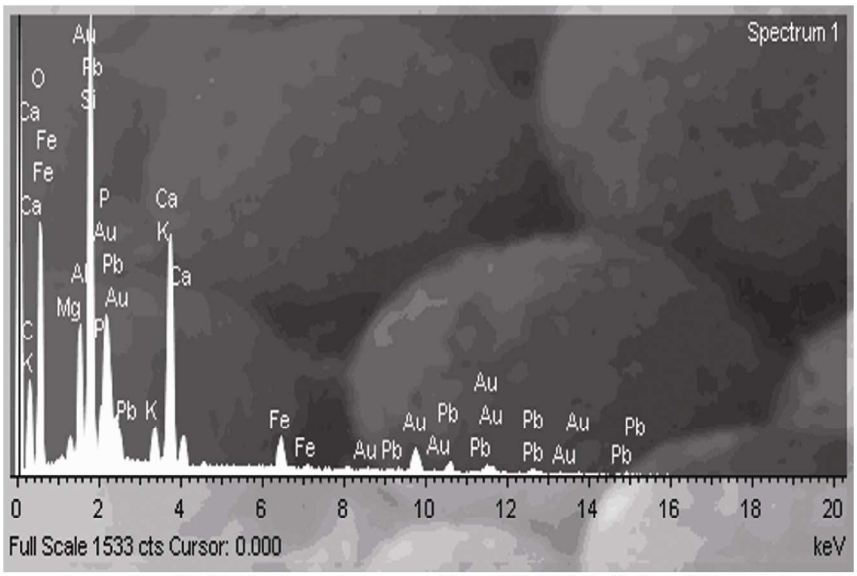


Figure 1. a-SEM of interaction zone DE=300·103J/m2, b- EDX spectrum 1

Table 1. Chemical composition of glass, weight%

Spectrum	In stats.	C	Na	Mg	Al	Si	P	K	Ca	Ti	Fe	Cu	Pb	O	Total
Spectrum 1	Yes	17.12	0.00	0.42	2.33	7.43	0.89	1.02	6.98	0.00	0.00	0.00	3.00	60.80	100
Spectrum 3	Yes	10.51	0.00	0.32	1.69	12.33	0.61	0.58	1.79	0.00	0.00	2.29	22.20	47.67	100

Acknowledgments

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Наукове видання

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