MODELING FORMALISMS AND EXPERIMENT IN THE APPROACH OF LASER BEAM INTERACTION WITH MATERIAL AND APPLICATION

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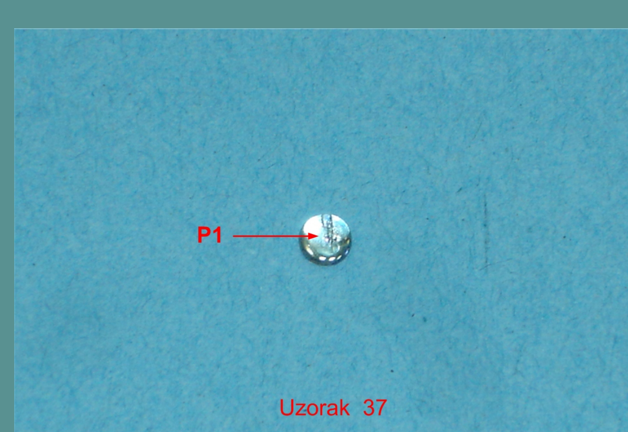
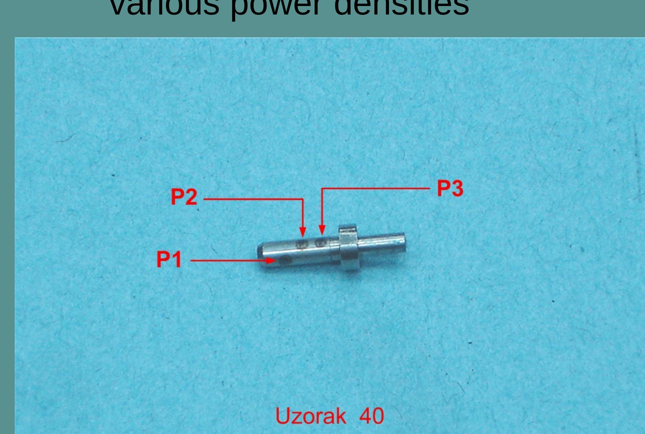
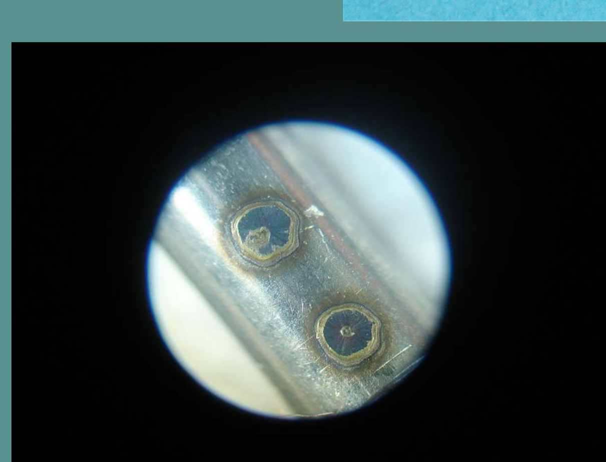
Abstract: Depending on the type of material and the dynamic mode of the selected operating regime of the quantum generators-lasers, there are many different classified approaches from different areas of the standard type or specific / phenomenological approaches or approximately derived fast formulas. In the paper, first part deals with analysis, the second part with experiments and the third part with selected simulations on different materials. There is still a lack of results in the literature, both on known and modern materials / new laboratory types . A lot of detailed models are covered by computer support, so part of the paper deals with selected software support. The obtained results of the interaction show the quantifications of the interaction and the selection of more important parameters.The repeatibility and interpretation demand particular discussion. The analyses rely on developed formalisms, and on attempts where analogies with the main outputs are related to various material properties and measurable parameters.

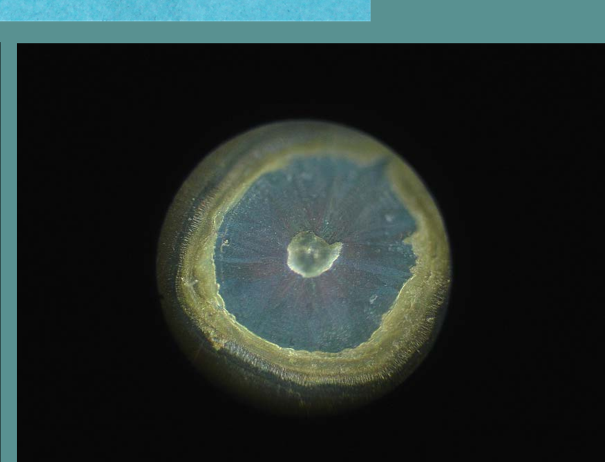
At fig. 1--- are macroscopic sample recordings of colimation lense damaged by Nd^{3+}YAG laser, with possible power densities and parameters provided by the jewlery welding laser: 390V,100ms,0.5Hz,4.1kW,26J,2957J/cm^2



Metallic fiber optic ferrule damaged at 3 locations by Nd^{3+}YAG laser at 3 various power densities

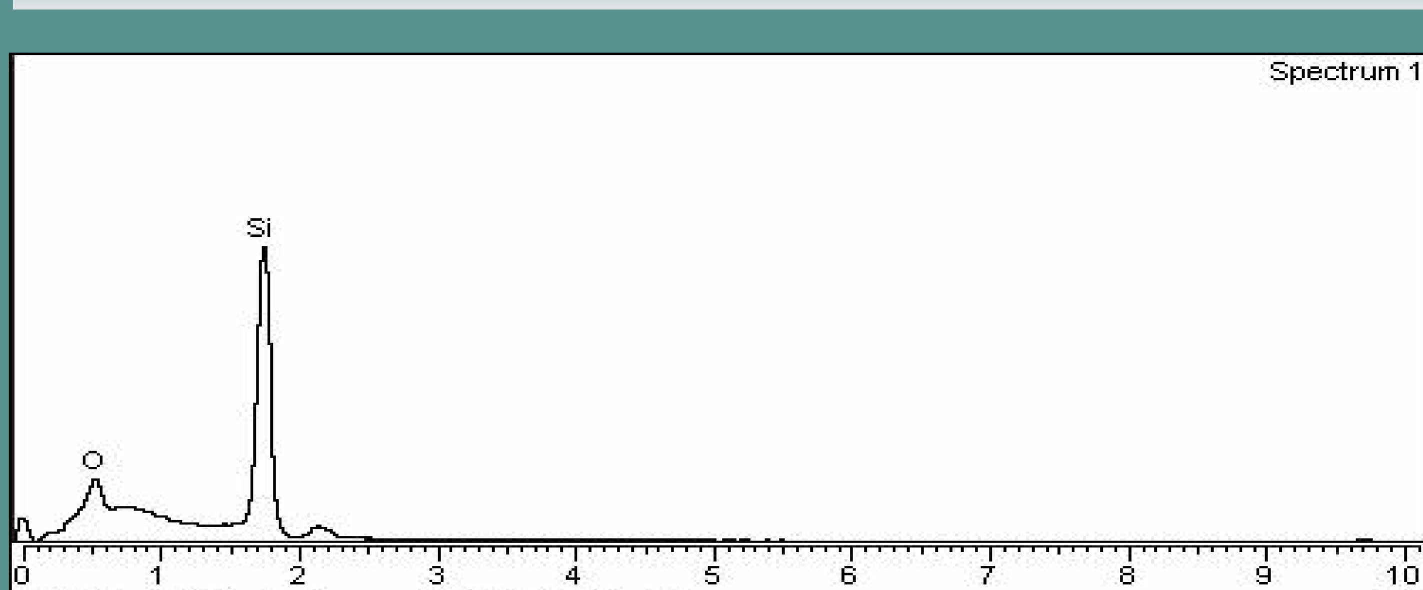






XRD analysis of monomode optical fiber.
These analyses should always be performed before and after laser beam exposures. Some results are presented here in the following Table and graphic.

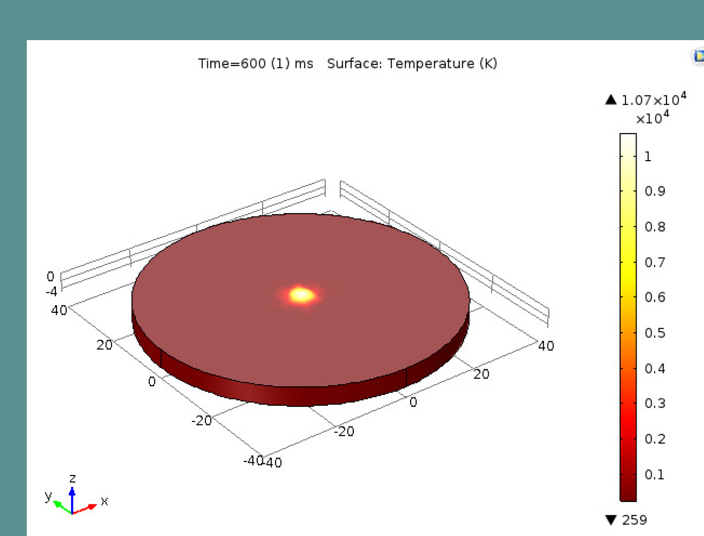
Element	App Conc.	Intensity Corrn.	Weight%	Weight% Sigma	Atomic %
O K	21.12	0.3917	48.80	0.72	62.67
Si K	48.41	0.8606	50.91	0.72	37.24
Cu K	0.25	0.7995	0.28	0.09	0.09
Totals			100.00		

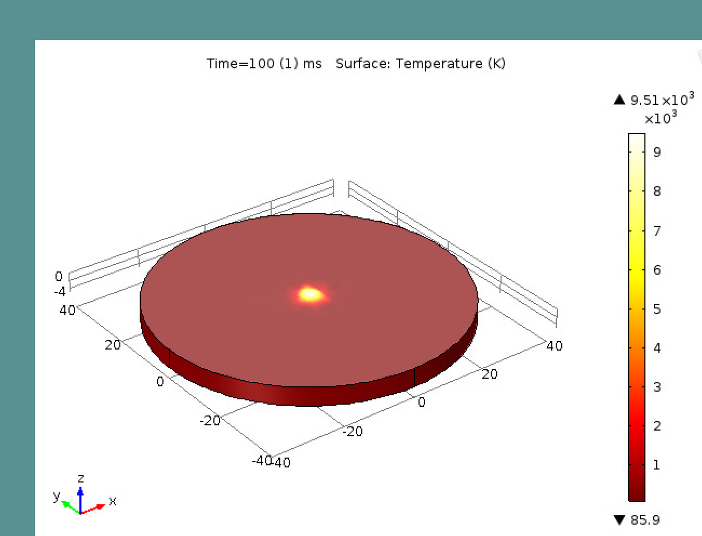


In systems containing optical fibers and respective components, depending on the purpose of optical system, they usually conduct coherent light through commercial or special fibers, designed for specific purposes, including communications, measuring equipment, computer hardware, Information Technologies, especially laser experiments, medicine, etc.
In that purpose, it is necessary to make many joints (splices), which, depending on the type of the cable and containing fibers (monomode or multimode) is achieved by collimation systems of lenses, connectors, fused permanent joints, mechanical methods, etc. Laser achieved joints are among relatively new processes. The presentation of interaction in this poster (Sreckovic et al), as well as in poster (Mirjanic et al) contain selected cases, ranging from total destruction of a component, appearance of plasma, smoke, to joining or cutting of fibers, or damaging optical fibers and components. The analyses include damages in figs. f1-f5. The analyses were made on light microscope, SEM, etc. including chemical composition of components/fibers before and after interaction (by XRD with SEM).

Attempted laser welding of optical fibers by Nd^{3+}YAG laser and some possible working parameters.

In fig below is given thermal distribution provide by computer simulation in Comsol Multiphysics v5.2. For laser parameters is taken: 100ms,0.5Hz,4.1kW,26J,2957J/cm^2. Fig represented time after first pulse (t=100ms) and after second pulse (t=600ms), respectively.





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Key words: modeling, lasers, materials.