SELECTED RESULTS AND MODELING OF THE APPLICATION OF LASER BEAMS IN DENTISTRY ON BIO AND PROSTHETIC MATERIALS

ĐORĐE MIRJANIĆ[1], MILESA SREĆKOVIĆ[2], VLADAN MIRJANIĆ[1], SVETLANA PELEMIŠ[3],

ALEKSANDAR BUGARINOVIĆ[2], DRAGAN DRUŽIJANIĆ[2]

[1]UNIVERSITY OF BANJA LUKA, FACULTY OF MEDICINE, STUDY PROGRAM OF DENTAL MEDICINE,

REPUBLIC OF SRPSKA, B&H

[2]FACULTY OF ELECTRICAL ENGINEERING BELGRADE, UNIVERSITY OF BELGRADE, SERBIA

[3]FACULTY OF TECHNOLOGY ZVORNIK, UNIVERSITY OF EAST SARAJEVO,

REPUBLIC OF SRPSKA, B&H

Abstract: The interaction of lasers has branched out in many different directions, towards medicine, to the type of prosthetic materials, but also in relation to more generally accepted fundamental methods. Although in any model there is a tendency to assess the possible effects as closely as possible, especially in dentistry where it is a matter of surgical procedures, it is of interest to know the transformations of materials and obtain new chemical compounds that can be harmful to living organisms. This calls for strict adherence to dosimetric principles (primarily meaning laser dosimetry).

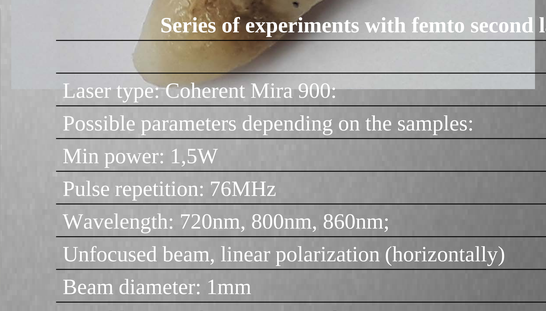
The paper shows the „useful" initiation of disintegration processes on selected materials (gradual removal of layers of bio or prosthetic materials / processes by separation, ejection and formation of dm/dE where m-mass and E- energy are delivered in defined spatial temporal r, t space, formed microstructures for classical and modern materials of interest in dentistry.

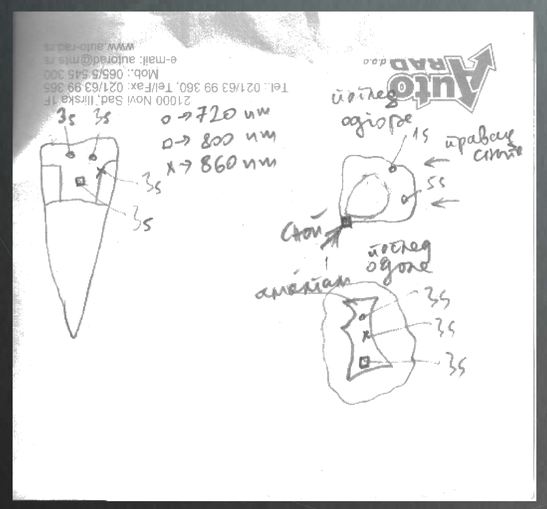
Key words: dentistry, modeling, lasers, materials.

Only some cases of performed experiments are presented in the following macroscopic views of damaged speciments, where are:

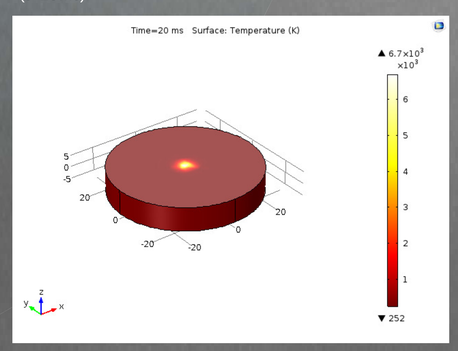
- Natural tooth with composites and amalgam fillings
- Thermoplastic material for prosthetic purposes, Valplast'' Acrylic tooth
- Foundation and tooth for partial and full prostheses,
- Some photo sensible layers, the detail of commercial solar components

Damages provoked by millisecond pulse regime can be seen, but the femtosecond damages should be analyzed by SEM microscopy. The detailed analyses of provoked processes should be performed by precise light microscopy analyses before SEM, XRD and some spectroscopic methods, as FIR, IR, etc. (Experimental part should be complemented with the data on poster Sreckovic et al. at this conference.)





In fig below is given thermal distribution provide by computer simulation in Comsol Multiphysics v5.2 for dentin. For laser parameters is taken: 20ms,1Hz, 300J/cm2. Fig represented time after first pulse (t=20ms).



Series of experiments with femto second lasers:
Laser type: Coherent Mira 900:
Possible parameters depending on the samples:
Min power: 1,5W
Pulse repetition: 76MHz
Wavelength: 720nm, 800nm, 860nm;
Unfocused beam, linear polarization (horizontally)
Beam diameter: 1mm
Possible time of exposition in this experiment: 1s, 3s, 5s
For conclusion: the highest effects and damage occurred at 720nm

Series of experiments with Nd^{3+}:YAG laser:
Laser of interest for medicine: eg. Dermatology, dentistry
Pulse duration t=20ms
Energy density: 300J/cm²
Pulse repetition: 1Hz
Time of interaction/exposition: 10 pulses in the same location
The damage is marked by black arrows

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