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Application of the Laser Microspectral Analysis in Dentistry: Mikroleakage evaluation in fixed partial dentures

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INTRODUCTION: This method was first introduced in 1962 and was used specially to investigate the surface of the metals. The laser microspectral analysis device consists in an infrared pulsed laser, usually with ruby, or neodimium doped glass as active medium.

METHODS: The laser microspectral analysis device LMA-1 (Carl Zeiss, Jena), equipped with a diffraction spectrometer PGS-2 (Carl Zeiss, Jena). This laser have a resonator with glass doped Nd3+. The output energy of the laser is 0.5-1.2 Joule/pulse λ=1060 nm. The LMA-1 system has mirror lens 40x, used to visualise the explored surface, which can be interchanged with 10 X lens, used to focus the laser pulse. The energy of the pulse was taken so that the diameter of the crater was around d = 50 µm and the depth of h = 35 µm. The corresponding voltage of the flash lamp is around 2 kV. For this, correspond a mass of vapors of around m= 0.1 µg. The voltage on the electrodes can be taken in the interval 0.5 – 3 kV. For the electric discharge it was used two graphite electrodes. The image of the electric discharge was focused on the aperture of the spectrograph using a collimating system. The input aperture of the spectrograph was taken of 10 µm. The energy of the laser pulse can be adjusted by the voltage value of a high voltage pulse generator. For these microanalysis devices there are used lasers operated in the visible and infrared region. The active medium of these lasers is glass doped Nd ions, corresponding to a laser ray wavelength of 1060 nm, and the ruby, corresponding to a wavelength of 694.3 nm. The energy of the lasers used is around 0.5-2 Joule/pulse. Above the crater there are situated two graphite electrodes, connected to a high voltage source. The distance between the electrodes is taken from 1 to few millimeters. For a due distance between the electrodes, the value of high voltage U_E is take so that to be less and closed to breakdown voltage of the air from the vicinity of the probe, in absence of the plasma produced by the pulse. This value can be taken experimentally.

RESULTS: Results that a laser pulse will produce between the electrodes connected to the U_E voltage a jet of plasma, which contain the atoms ejected from the crater. This jet of plasma will initiate an electric discharge between the electrodes. This discharge will excite the atoms from the plasma, after which, by transitions from the excited states, it will emit photons, with due wavelengths and intensities. Commonly, there are used graphite electrodes. The radiation produced by the discharge is focused to the input slit of a spectrophotometer, or of a spectrograph. The spectrophotometer will give the emission spectrum of the atoms contained in the plasma. From this spectrum it can be established the content of atoms and their concentration from the crater. This spectrum corresponds to the UV and visible region. In order to made accurate measurements, an accurate delay between the laser pulse and the electric discharge must be taken. This delay is necessary, in order to produce the electric discharge, i.e. the excitation of the atoms, when the jet of plasma which contain the atoms arrive at the electrodes. The data were gathered in various tables of chemical elements showing the quality and the quantity of mikroleakage.

DISCUSSION & CONCLUSIONS: The method of laser microspectral analysis is a method of punctual method of analysis, which permits to investigate small quantity of material, around 0.1 µg.

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