Abstract:

The dissertation consists of two parts. Part A deals with Laser Induced Breakdown Spectroscopy (LIBS) analysis of human teeth by employing Nd: YAG laser (1064 nm, 10 ns) for the evaluation of plasma parameters as well as elemental analysis. The plasma parameters i.e. electron temperature and electron number density of laser induced teeth plasma at various fluences ranging from 1.3 J/cm^2 to 10.5 J/cm^2 have been evaluated. The electron temperature varies from 5189 K to 8288 K, whereas, number density varies from 1.5 x 10^{18} cm^{-3} to 3.8 x 10^{18} cm^{-3}. Both parameters show an increasing trend up to a certain value of laser fluence i.e. 2.6 J/cm^2, then decreasing trend and afterwards the saturation is observed for increasing fluence from 2.6 J/cm^2 to 10.5 J/cm^2. The elemental analysis was also performed at constant laser fluence of 2.6 J/cm^2 by evaluating the variation in detected elemental concentration of Ca, Fe, Sr, Zn and Pb in three different parts of human teeth i.e. enamel, dentine and cementum. The elemental analysis reveals that the highest concentration of matrix element i.e. Ca as well as microminerals (Fe, Sr, Zn, Pb) is found in enamel then in dentine and the minimum in cementum. The concentration of matrix element is also compared with self-fabricated $CaCO_3$ pellet. The enamel is identified as the most deciduous part of human teeth.

In the second part i.e. part B of dissertation, the variation in surface morphology and hardness of human deciduous teeth samples after laser irradiation at different wavelengths and energies has been investigated. For this purpose laser radiations at three different wavelengths i.e. IR (1064 nm) visible (532 nm) and UV (248 nm) were selected. Deciduous teeth samples were irradiated at four different energies of 70 mJ, 80 mJ, 90 mJ and 100 mJ for 500 numbers of pulses for all wavelengths. Scanning Electron Microscope (SEM) analysis was carried out to reveal the surface morphological evolution of teeth samples, whereas, Vickers micro hardness tester was employed to measure the change in hardness of laser treated samples. SEM and hardness analysis reveals that laser wavelength as well as energies of laser radiations has significantly influenced the surface morphology and hardness of teeth samples. Various structures cracking, melting, bumps and globules are observed on irradiated surface of dentin. The significant decrease in hardness is observed for both wavelengths and is attributed to evaporation of carbon content. The increasing trend in hardness with increasing energies is obtained which is due to evaporation of water along with carbon content, resolidification and re-organization of inorganic contents.