Photothermal Radiometry Analysis on Fractured Human Bones

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The analysis of biomaterials made of hydroxyapatite is an active research area due to its medical relevance. Photothermal techniques constitute highly valuable tools in those cases. In this work the analysis of thermal diffusion in bones with fractures is presented using phototermal radiometry. Two kinds of fractures were analyzed natural ones and mechanically induced. The experiments were performed scanning a laser beam longitudinally in a perpendicular direction to the crack. It is shown that when the laser spot is close to the edge of the cracks the photothermal signal increases. The change and shape of the photothermal signal is studied as a function of the width of the crack. A model based on changes in thermal effusivity due to the cracks is developed and compared with the experimental data. A systematic study of the photothermal radiometry signal phase and amplitude is performed as a function of the size of the crack for different materials: metals, ceramics, glassy carbon and bone. Special emphasis is placed on the analysis of the integrity and structure of bones that were previously mechanically and thermally stressed. The usefulness of the photothermal radiometric technique as well as the possibility of performing quantitative analysis of cracks in materials is discussed.