FTIR imaging on glass substrates evaluation of histological skin burn injuries specimens treated by femtosecond laser pulses

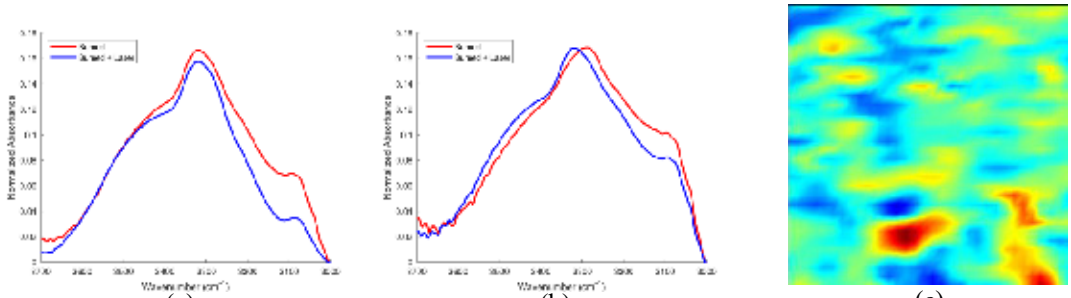
Denise ZEZELL[1], Pedro CASTRO[1], Matheus DEL-VALLE[1], Carlos CAMILLO-SILVA[1], Ricardo SAMAD[1], Wagner DE ROSSI[1] and Moisés SANTOS[1,2]

[1] *Center for Lasers and Applications, Nuclear and Energy Research Institute, Brazil*
[2] *Technology College, Amazonas State University, Brazil*

zezell@usp.br

ABSTRACT

Burn injuries continue to be one of the leading causes of unintentional death and injury in low- and middle-income countries [1]. Burns are considered an important public health problem, because in addition to physical problems that can lead the patient to death, they cause psychological and social damage. An estimated 180,000 deaths every year are caused by burns [2]. The use of infrared (IR) spectroscopy for studying biological specimens is nowadays a wide and active area of research. The IR microspectroscopy has proved to be an ideal tool for investigating the biochemical composition of biological samples at the microscopic scale, as well as its fast, sensitive, and label-free nature [3]. IR image spectral histopathology has shown great promise as an important diagnostic tool, with the potential to complement current pathological methods, reducing subjectivity in biopsy samples analysis. However, the use of IR transmissive substrates which are both fragile and prohibitively very expensive, hinder the clinical translation. The goal of this study is to evaluate the potential of discriminating healing process, in burned skin specimens treated with ultrashort pulses laser 3 days after the burn. This study is considering a previous paper [4], in which it analyzed only micro-ATR-FTIR spectra of a frozen sample point. The specimens were obtained from third degree burn wound. The wounds treatment were performed three days after the burn, and the animals were sacrificed 3 and 14 days post-treatment. Using coverslipped H&E stained tissue on glass from previous histopathological analysis and applying the analytical techniques PCA and K-means on N−H, O−H, and C−H stretching regions occurring at 2500−3800 cm^{-1} (high wavenumber region), were possible to discriminate burned epidermal and dermal regions from irradiated in same regions on sample. In the figures is shown the average spectrum at (a) day 3 and (b) day 14. , in both there were increase of burned+laser treated bands. The great potential of this study was to analyse coverslipped H&E stained tissue on glass, without compromising the histopathologist practices and contribute for clinical translation.



(a) (b) (c)

Figures: *Average spectra of (a) Burned and burned+laser at day 3 , (b) Burned and burned+laser at day 14 and (c) Hyperspectral image of dermal region at day 14.*

ACKNOWLEDGEMENTS: FAPESP (CEPID 05/51689-2, 17/50332-0); CAPES/PROCAD (88881.068505/2014-01); CNPq (INCT-465763/2014-6, PQ-309902/2017-7) and CNEN.

REFERENCES

[1] Peck MD, Jeschke MG. Epidemiology of burn injuries globally. Burns. 37(7), 2011.

[2] Mock C, Peck M, Peden M, Krug E, World Health Organization (WHO), 2008.

[3] Bhattacharyya S. Journal of Physical Chemistry & Biophysics. 5(4), 2015.

[4] Dos Santos MO et al. Biomedical Optics Express. 8(3), 1575-88, 2017.