Accepted Manuscript

The biochemical, nanomechanical and chemometric signatures of brain cancer

Halina Abramczyk, Anna Imiela

PII:	S1386-1425(17)30515-2
DOI:	doi: 10.1016/j.saa.2017.06.037
Reference:	SAA 15253
To appear in:	*Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*
Received date:	26 April 2017
Revised date:	28 June 2017
Accepted date:	29 June 2017

Please cite this article as: Halina Abramczyk, Anna Imiela , The biochemical, nanomechanical and chemometric signatures of brain cancer, *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* (2017), doi: 10.1016/j.saa.2017.06.037

The biochemical, nanomechanical and chemometric signatures of brain cancer.

Halina Abramczyk*, Anna Imiela

Lodz University of Technology, Faculty of Chemistry, Institute of Applied Radiation Chemistry, Laboratory of Laser Molecular Spectroscopy, Wroblewskiego 15, 93-590 Lodz, Poland.

*Corresponding author: abramczy@mitr.p.lodz.pl

Abstract

Raman spectroscopy and imaging combined with AFM topography and mechanical indentation by AFM have been shown to be an effective tool for analysis and discrimination of human brain tumors from normal structures. Raman methods have potential to be applied in clinical practice as they allow for identification of tumor margins during surgery. In this study, we investigate medulloblastoma (grade IV WHO) (n= 5) and the tissue from the negative margins used as normal controls. We compare a high grade medulloblastoma (IV grade), and non-tumor samples from human central nervous system (CNS) tissue. Based on the properties of the Raman vibrational spectra and Raman images we provide a real–time feedback that is label-free method to monitor tumor metabolism that reveals reprogramming of biosynthesis of lipids, and proteins. We have found that the high-grade tumors of central nervous system (medulloblastoma) exhibit enhanced level of β-sheet conformation and down-regulated level of α-helix conformation when comparing against normal tissue. We have shown that the ratio of Raman intensities I2930/I2845 at 2930 and 2845 cm^{-1} is a good source of information on the ratio of lipid and protein contents. We have found that the ratio reflects the lipid and protein contents of tumorous brain tissue compared to the non-tumor tissue. Almost all brain tumors have the Raman intensity ratios significantly higher (1.99 ±0.026) than that found in non-tumor brain tissue, which is 1.456 ± 0.02, and indicates that the relative amount of lipids compared to proteins is significantly higher in the normal brain tissue. Mechanical indentation using AFM on sliced human brain tissues (medulloblastoma, grade IV) revealed that the mechanical properties of this tissue are strongly heterogeneous, between 1.8 and 75.7 kPa, and the mean of 27.16 kPa. The sensitivity and specificity obtained directly from PLSDA and cross validation gives a