Data Article

Correlative Brillouin and Raman spectroscopy data acquired on single cells

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Article history:
Received 31 December 2019
Accepted 24 January 2020
Available online 5 February 2020

Keywords:
Biophotonics
Brillouin spectroscopy
Raman spectroscopy
Cell mechanics

Abstract

The distribution of chemical species and the mechanical modulation inside a single cell or tissue are of fundamental importance to characterize their physiological activity or their pathological conditions [1–4]. Here we analyse these properties by means of label free, non invasive, spectroscopic methods. In particular, we use a recently developed micro-spectrometer, which acquires simultaneously Raman and Brillouin spectra on the same point with subcellular resolution [5]. The techniques ability to analyse the chemical composition and the mechanical properties of single cells has been tested on NIH/3T3 murine fibroblast cells grown in adhesion on silicon substrates. Here we report the data acquired from fixed cells after their oncogenic transformation. Mechanical and chemical evolution is evident by direct inspection of raw data. Sharing our experimental records can be valuable for researchers interested in the analysis of single cells by Raman and Brillouin spectroscopy in order: i) to compare data acquired by different set-ups and ii) to correctly model the fitting functions.

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https://doi.org/10.1016/j.dib.2020.105223
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1. Data description

The growing importance to characterize mechanical properties, in addition to chemical ones, in biological framework is widely recognized in recent literature [1–4]. The data shared in the present paper were recorded investigating a single fixed cell using the novel experimental set-up recently assembled in our Lab able to simultaneously characterize chemical and mechanical properties of the investigated material [5–7]. The schematic picture of the optical system is reported in Fig. 1a) (upper panel). The Brillouin and Raman spectra simultaneously acquired probing the same point inside a single cell is reported in Fig. 1b) (lower panel).

The whole dataset is archived in BRaM_Dataset.zip present in “Appendix A. Supplementary data” of the present article as zip file. The data were collected moving with a step of 2 μm crossing the cell from one side to the other, entering from the plasmatic membrane, through the cytoplasm into the nucleus, and exiting from the other side. A selection of the collected Brillouin spectra are reported in Fig. 2 and the low and high frequency region of the Raman spectra are reported in Fig. 3 and Fig. 4 respectively. The right and the left panel of the figures show the measurements along two perpendicular directions within the cell (x and y axis). Directly from the raw data, it is possible to appreciate modifications in the spectral shape. In fact, moving through different cellular points, modulation in the elastic properties is evidenced by the shift and broadening of the Brillouin peak related to the emergence of high frequency component (for the detailed analysis see Ref. [5]). Moreover, modifications in the relative concentration of the different
chemical species are visible by changes in the relative intensity of the Raman peaks present in both high and low frequency range of the spectra.

2. Experimental design, materials, and methods

The data were acquired using the Brillouin-Raman micro-spectroscopy set up extensively described elsewhere [5,6]. In brief, the laser light is focalized by a water immersion objective into the cell and the scattered light collected by the same objective is analysed in frequency by a HC-Tandem Fabry-Perot interferometer and by a single grating Raman spectrometer.

NIH/3T3 murine fibroblast cell line was purchased from American Type Culture Collection (ATCC). Cells were grown in Dulbecco Modified Eagle’s Medium (DMEM) containing 10% (v/v) heat-inactivated fetal bovine serum (FBS), 100 U/mL penicillin, 100 U/mL streptomycin and maintained at 37 °C in a 5% CO₂ humidified atmosphere. Cells were seeded in 6-well multiplates and transfected using Lipofectamine LTX with the expression vector pcDNA6/myc-His encoding the constitutively active mutant H-RasV12. The vector expressing the Ras mutant was previously described [15]. This mutation replaces...
the amino acid glycine with a valine, which makes the GTPase constitutively GTP bound. Transfected fibroblasts were selected using 4 μg/ml Blasticidin-S for 5 days. The expression of H-RasV12 was assessed by immunoblotting as previously shown [5]. Selected cells were trypsinized and seeded in silicon substrates sterilized with 100% ethanol washing and UV irradiation. Paraformaldehyde fixation

Fig. 2. Sequence of Brillouin spectra probing different position inside the cell.

Fig. 3. Sequence of selected Raman spectra probing the frequency region between 1000–1800 cm⁻¹ acquired in different positions inside the cell.
was performed by incubating cells with 4% paraformaldehyde in PBS for 10 minutes at room temperature, then cells were washed twice with PBS. For the spectroscopic measurements, the cells were immersed in phosphate-buffered saline (PBS).

Acknowledgments

SC acknowledges the support from PAT (Autonomous Province of Trento) (GP/PAT/2012) ‘Grandi Progetti 2012’ Project ‘MaDEleNA’. MM acknowledges the European Commission under the EU Horizon 2020 Programme Grant Agreement No: 644852, PROTEUS. SC acknowledges financial support from Consiglio Nazionale delle Ricerche-Istituto Officina dei Materiali.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2020.105223.

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