INFRARED SPECTROSCOPY OF LIVE EPITHELIAL CELLS

M. Golosovsky¹, V. Yashunsky¹, T. Marciano¹, A. Zilberstsein¹, V. Lirtsman¹, D. Davidov¹, B. Aroeti²
¹The Racah Institute of Physics, The Hebrew University of Jerusalem, Israel
²Department of Cell and Animal Biology, The Alexander Silberman Institute of Life Science, The Hebrew University of Jerusalem, Israel

ABSTRACT

We demonstrate a real-time and label-free technique to characterize the live cells on substrate. The technique is based on infrared reflectivity measurements using an FTIR spectrometer with collimated beam. This technique combines information on molecular vibrational modes inherent to Fourier-transform spectroscopy with structural information provided by the angular-dependent reflectivity in the surface plasmon regime.

Moreover, we use the infrared light for excitation of waveguide modes inside living cell monolayer. This yields kinetics of cell-cell attachment and cell height during cell spreading, monolayer formation, calcium depletion and replenishment.

PRINCIPLES OF MEASUREMENT

Surface plasmon (SP) senses the part of the layer in contact with substrate. Waveguide modes (TMn) sense the whole layer.

MEASUREMENT EXAMPLES

SURFACE PLASMON SPECTROSCOPY YIELDS COMPLEX REFRACTIVE INDEX OF CELLS

WAVEGUIDE MODE SPECTROSCOPY YIELDS STRUCTURAL INFORMATION ON CELLS

METHODOLOGY

Cells live in growth medium (mostly water).

Strong water absorption prevents infrared spectroscopy using plane waves. Surface plasmon wave probes cells directly and is less affected by water absorption.

Flow chamber

Surface plasmon wave is a surface electromagnetic wave propagating along the metal-dielectric interface.

Surface plasmon resonance appears as a sharp dip in the angular-dependent reflectivity.

Waveguide modes (TMn) are adapted to cells live in growth medium. Strong water absorption prevents infrared spectroscopy using plane waves. Surface plasmon wave probes cells directly and is less affected by water absorption.

Flow chamber

Surface plasmon wave is a surface electromagnetic wave propagating along the metal-dielectric interface.

Surface plasmon resonance appears as a sharp dip in the angular-dependent reflectivity.

Waveguide modes (TMn) are adapted to cells live in growth medium. Strong water absorption prevents infrared spectroscopy using plane waves. Surface plasmon wave probes cells directly and is less affected by water absorption.

Flow chamber

Surface plasmon wave is a surface electromagnetic wave propagating along the metal-dielectric interface.

Surface plasmon resonance appears as a sharp dip in the angular-dependent reflectivity.

Waveguide modes (TMn) are adapted to cells live in growth medium. Strong water absorption prevents infrared spectroscopy using plane waves. Surface plasmon wave probes cells directly and is less affected by water absorption.

Flow chamber

Surface plasmon wave is a surface electromagnetic wave propagating along the metal-dielectric interface.

Surface plasmon resonance appears as a sharp dip in the angular-dependent reflectivity.

Waveguide modes (TMn) are adapted to cells live in growth medium. Strong water absorption prevents infrared spectroscopy using plane waves. Surface plasmon wave probes cells directly and is less affected by water absorption.

Flow chamber

Surface plasmon wave is a surface electromagnetic wave propagating along the metal-dielectric interface.

Surface plasmon resonance appears as a sharp dip in the angular-dependent reflectivity.

Waveguide modes (TMn) are adapted to cells live in growth medium. Strong water absorption prevents infrared spectroscopy using plane waves. Surface plasmon wave probes cells directly and is less affected by water absorption.

Flow chamber

Surface plasmon wave is a surface electromagnetic wave propagating along the metal-dielectric interface.

Surface plasmon resonance appears as a sharp dip in the angular-dependent reflectivity.

Waveguide modes (TMn) are adapted to cells live in growth medium. Strong water absorption prevents infrared spectroscopy using plane waves. Surface plasmon wave probes cells directly and is less affected by water absorption.

Flow chamber

Surface plasmon wave is a surface electromagnetic wave propagating along the metal-dielectric interface.

Surface plasmon resonance appears as a sharp dip in the angular-dependent reflectivity.

Waveguide modes (TMn) are adapted to cells live in growth medium. Strong water absorption prevents infrared spectroscopy using plane waves. Surface plasmon wave probes cells directly and is less affected by water absorption.

Flow chamber

Surface plasmon wave is a surface electromagnetic wave propagating along the metal-dielectric interface.

Surface plasmon resonance appears as a sharp dip in the angular-dependent reflectivity.

Waveguide modes (TMn) are adapted to cells live in growth medium. Strong water absorption prevents infrared spectroscopy using plane waves. Surface plasmon wave probes cells directly and is less affected by water absorption.