

Photo-excitation mechanism and application of the bio-organic interface

by

Prof. Guglielmo Lanzani

Center for Nano Science and technology, Istituto Italiano di Tecnologia
Dipartimento di Fisica, Politecnico di Milano

Date: 15 April 2014, Tuesday
Time: 11.00am to 12.00pm
Venue: MAS Executive Classroom 1 (SPMS-MAS-03-06)
Host: Asst. Prof. Cesare Soci



Abstract

The possibility to excite a living cell through a controlled stimulus offers a wealth of applications in neuroscience and medicine, for healing, studying and diagnostic. There are several techniques that have been proposed and tested, mainly based onto two different actions: by electrical stimulation and by light stimulation. The latter has a number of advantages, being less invasive, better confined, more selective. We propose here a new approach, based on light absorbing polymer layers in contact with the cell. First experiment in primary hippocampal neurons in vitro validated the approach, showing that a short light pulse can elicit an action potential. This prompted further investigations and the recent demonstration of light excitation in explanted blind retinas. A parallel study was carried out on HEK line cells, as simpler model for the bio/ organic, natural/artificial interface. This study shows that light absorption in the polymer causes a local heating at the polymer surface that induces a temperature change in the cell membrane. Electrical parameter of the cell, conductance and capacity, are changed by the temperature gradient and result into a modification of the cell membrane potential. This mechanism is fully characterized and quantitatively reproduced by a simple equivalent circuit model.

Short Biography

Guglielmo Lanzani is head of the Center for Nano Science and Technology of the Italian Institute of Technology, and full professor in physics at Politecnico di Milano. His research regards the photophysics of conjugated carbon materials (organic semiconductors, polyconjugated compounds and carbon nanotubes) and nanostructures, including devices and applications, as reported in more than 220 papers. Leading activities are on solar energy conversion and artificial retina.