Gimmi Ratto. Institute of Neuroscience CNR and NEST, Scuola Normale Superiore, Pisa, Italy.

Making the invisibile visibile: cell life seen at the single and two-photon microscope.

The last 10 years have seen the explosive development of imaging techniques that allow peering at cell life with unprecedented temporal and spatial resolution. This revolution originates by the parallel development of optical sensors and of microscopy techniques apt at interrogating the sensors in living cells. The optical sensors are molecules which fluorescence properties are modified by the cellular environment, such as membrane potential, ionic concentration or other biochemical parameters. These molecules are either chemically synthesized, as the classical calcium indicators; or are genetically encoded, by fusing the cDNA of Fluorescent Proteins with specific transducer proteins.

The ever increasing fields of application of optical functional imaging are paralleled by the development of the microscopy techniques used to interrogate the fluorescent probes and to image the cellular function. The range of processes amenable to imaging is prodigiously vast and goes from molecular dynamics to structural changes of cell assemblies. Furthermore, the development of two-photon microscopy is opening up the possibility of imaging function in vivo in thick tissue, literally opening up the chance of imaging events occurring deep inside the intact brain of the anaesthetized animal in a relatively non-invasive way.

In this talk we will describe some of the tools of the trade, showing applications in the study of signal transduction in living cells and of the brain function and structural plasticity in vivo.