Nonlinear optical microscopy for characterization of cultural heritage materials

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In 1961, and shortly after T.H. Maiman constructed the first laser device, P. Franken et al. discovered the effect of second harmonic generation. Since then, many new nonlinear optical phenomena have been exploited and, together with the description of their theoretical basis, have established the broad discipline of nonlinear optics. In nonlinear optical media, the dielectric polarization responds nonlinearly to the electric field of the light.

In this lecture, I will introduce the basic concepts of Nonlinear Optical Microscopy (NLOM), a series of techniques initially developed in the field of biomedical optics that allow surface mapping and profiling of multilayer, multicomponent structures. In NLOM, near infrared, ultrafast femtosecond laser excitation induces several nonlinear optical effects for high contrast imaging of solid samples. The modes of Multi-Photon Excited Fluorescence, and Second or Third Harmonic Generation provide non-destructive accurate structural information of substrates and objects and of their composition as a function of depth. Applications of NLOM for characterization of cultural heritage materials, with emphasis in painting layers and historical glasses, will be presented, highlighting the advantages of this approach.

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