Characterization of two- and three-photon absorption in the MeH-PPV.

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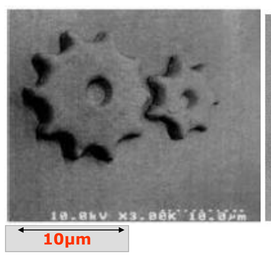
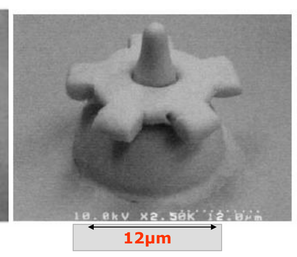
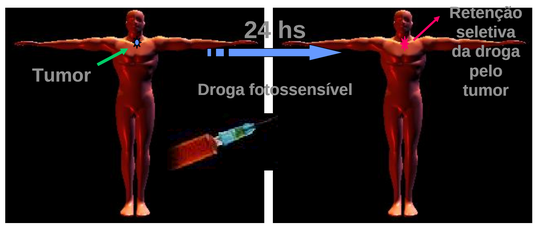
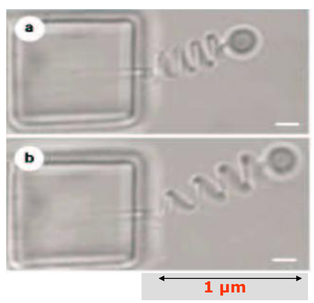
In recent years, conjugated polymers have attracted much attention due to its specials properties such as electrical conductivity and high nonlinear optical effects. In this work we report the study of multi-photon absorption in the conjugated polymer MeH-PPV. The process of two- and three-photon absorption has been studied due to its applicability in many fields of science. For example, it has been used in modern medicine for photodynamic therapy, photopolymerization, 3D optical data storage and also in the fabrication of micro devices. For this reason, the search for materials that present high two- and three-photon absorption cross-sections has grown up in the latest years. Multi-photon absorption takes place when, by focusing an intense source of light, the density of photon per unit of volume becomes so high that two or more photons can be simultaneously absorbed by the material. In this case, the absorbed energy is the sum of the energy of the isolated photons.

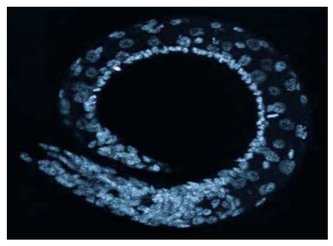
Technological applications of multi-photon absorption

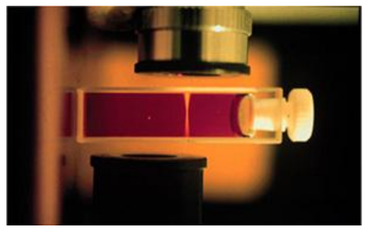




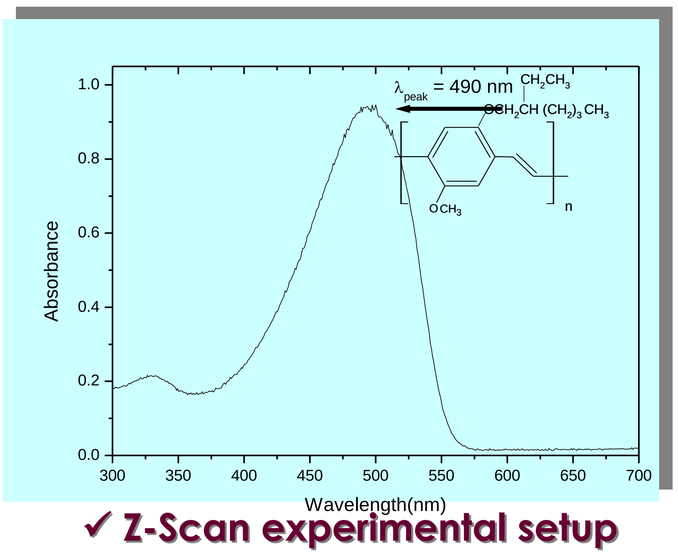




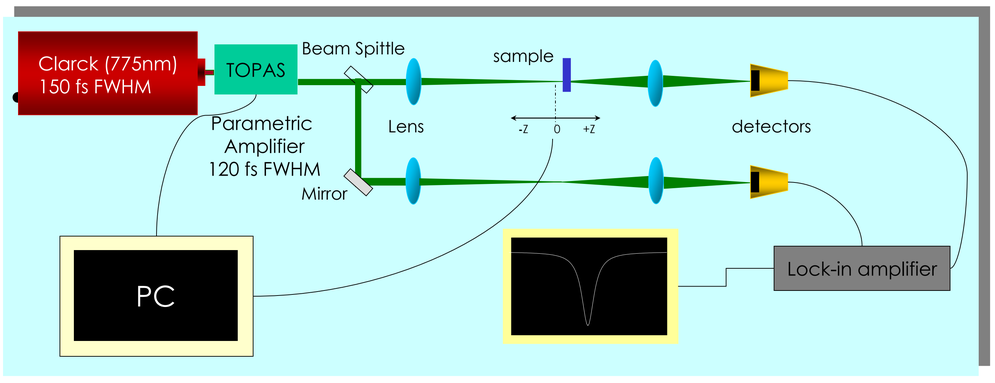




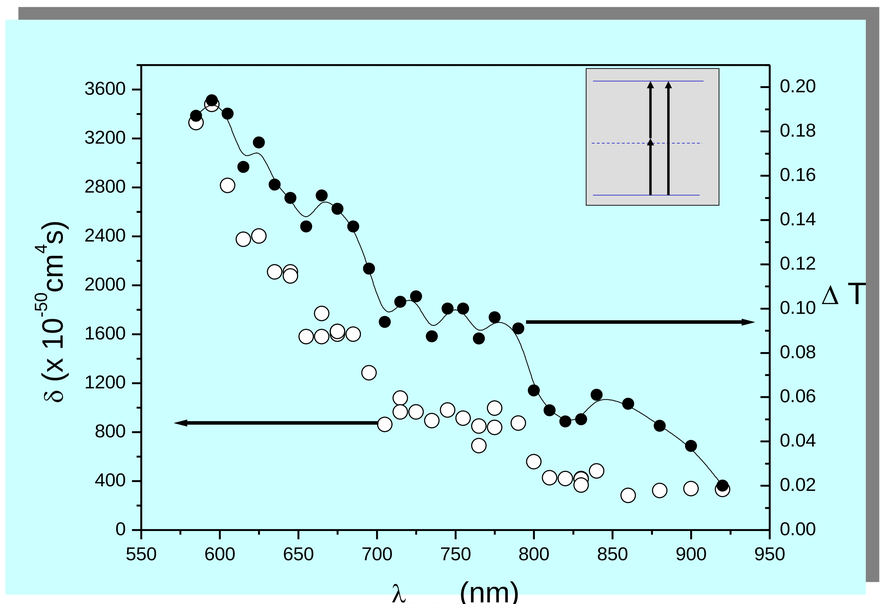
MeH-PPV molecular structure and absorption spectrum

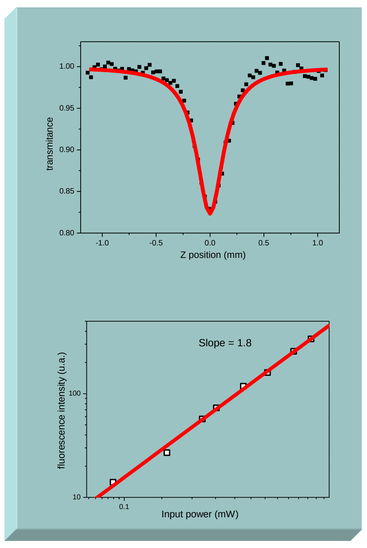


✓ Z-Scan experimental setup

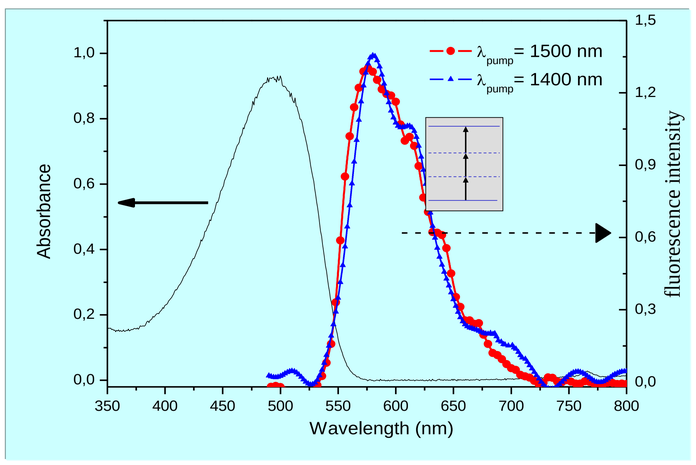


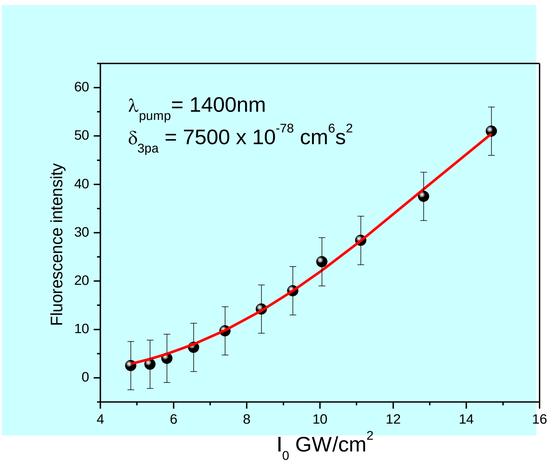
Our Z-scan experiment employs laser pulses from a commercial optical parametric amplifier (TOPAS) pumped by a 150 fs pulses at 775 nm delivered by a Ti:sapphire chirped pulse amplified system (CPA-2001, from Clark-MXR Inc.), operating at 1kHz repetition rate.





One can observe an increase of the 2PA process when we pump the material with wavelengths closer to the linear absorption band, due to the resonance enhancement. The MeH-PPV presents a large range of δ_{2PA} from 580 nm to 940 nm, which values are in the order of 3500x10^{-50} cm^{4}s up to 1x10^{-50} cm^{4}s, respectively.





$$Fluo = C_0\left\{1+\frac{1}{\left(I_0^3/I_s^3\right)}\left[e^{I_0^3/I_s^3}-1\right]\right\}$$, where C_0= constant, I_0 = intensity, I_s = saturation intensity, and $I_s = \frac{h\upsilon}{\sqrt[3]{\sigma_3'\tau}}$, σ_3' = 3PA cross-section, τ = pulse width

MeH-PPV also presents three-photon absorption (3PA), as can be seen from experiments of fluorescence Intensity X excitation Intensity. We can infer from the fluorescence spectra that the molecule is excited to the same energy level either pumped with 1400 nm or 1500nm. Using a model proposed by the literature, we estimated the 3PA cross-section for 1400 nm to be 7500 x 10^{-78} cm^{6}s^2, which is a typical value for organic compounds.

✓ Conclusions

MeH-PPV presents distinct process of two- and three-photon absorption, in a wide range of the VIS- and near IR spectra. Using a pump wavelength of 760 nm we found a two-photon absorption cross-section of 1000x10-50 cm^{4}s for this compound. The large δ_{2PA} observed close to the linear absorption band are due to the resonance enhancement of the nonlinearity. We could also observe the occurrence of 3PA process by fluorescence measurements, which gave δ_{3PA} = 7500 x 10-78 cm^{6}s^2 at 1400 nm, estimated using a model found in the literature.

FAPESP

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