Me-PPV chloroform solution degenerated two photon absorption spectrum

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Abstract

In this work we present results of the degenerated two-photon absorption (2PA) spectrum measurements from 300 to 520nm in Meh-PPV solution. The 2PA spectrum exhibit a strong band away from the fundamental linear absorption band.

Introduction

Among conjugated polymers the family of poly(phenylene-vinylene) (PPV) has attracted much attention due to its interesting optical and electrical properties [1]. Concerning nonlinear optics, large third order nonlinearities have been reported by several groups, specifically two-photon absorption (2PA). In this process two photons of longer wavelength are simultaneously absorbed by a chromophore that would normally be excited by a single photon with a shorter wavelength. Besides the ability to create excited states with photons of half the required excitation energy, the I^2 dependence of 2PA allows chromophores excitation with a high degree of spatial selectivity. In this way, the 2PA process have been attracting a great interest in different fields, such as chemistry, photonic and biological imaging. In this work we report the degenerated two-photon absorption (2PA) spectrum for MeH-PPV, obtained through the femtosecond Z-scan technique.

Experimental Setup

PPV-based polymers have been proved to be very promising materials for photonic application, due to the combination of their excellent film forming properties with interesting optical effects. The Meh-PPV solution used in this study was prepared in chloroform and placed in a 2-mm thick quartz cuvette to perform the linear and nonlinear optical measurements. The concentration of Meh-PPV used in this work was 10^{-4} mol/L in repeating unit. The absorption spectra in the UV-Vis region were obtained with a Cary 17A spectrophotometer.

Nonlinear optical measurements were carried out with the Z-scan technique [2], which is a simple and sensitive method to determine the degenerated 2PA coefficient β. Our open aperture Z-scan experiments employed laser pulses from a commercial optical parametric amplifier, TOPAS from Quantronix, pumped by a 150fs pulse at 775nm delivered by a Ti:sapphire chirped pulse amplified system CPA-2001 from Clark-MXR Inc., operating at 1 kHz repetition rate. The pulse energies used here were limited up to 0.01μJ to avoid photo-degradation of the polymer. The FWHM pulse duration delivered by the TOPAS was about 120fs, and the spatial profile of the laser beam presented an approximately Gaussian distribution.

Results and Discussions

Figure 1 shows an open aperture Z-scan measurements for MeH-PPV at 610 nm. This Z-scan signature presents a decrease in the normalized transmittance on the *z* position, which indicates, in non-resonant regime, a 2PA process. Similar Z-scan measurements were also obtained for the other wavelengths in order to determine the degenerated 2PA spectrum.

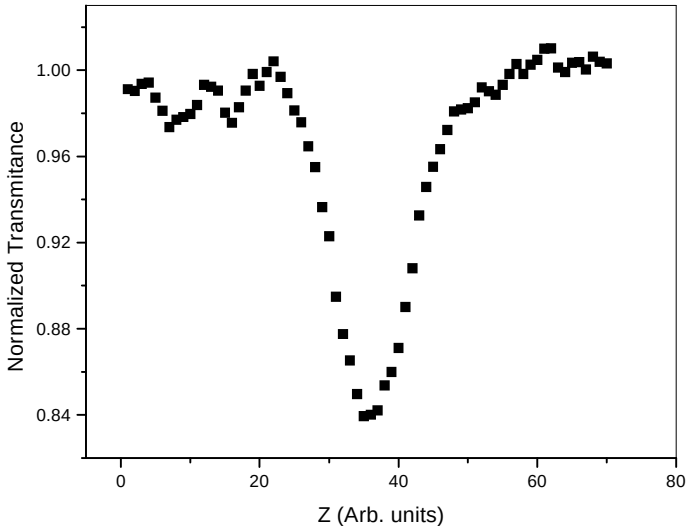

Figure 1: Open aperture Z-scan measurements at 610 nm for MeH-PPV.

The 2PA (closed circles) and linear (solid line) absorption spectra are plotted in Fig. 2 for MeH-chloroform solution. As can be seen the 2PA spectrum exhibit a strong band away from the fundamental linear absorption band, in agreement with result reported in the literature [3,4]. However, the 2PA peak we have found appear around 4.0eV, which correspond to two photons of 310nm, while in Ref. 4 the two photon absorption maximum was observed around 3.0eV. We believe that this difference is probably related to the picosecond pulse duration used in that paper, which certainly lead to some extra excited state absorption.

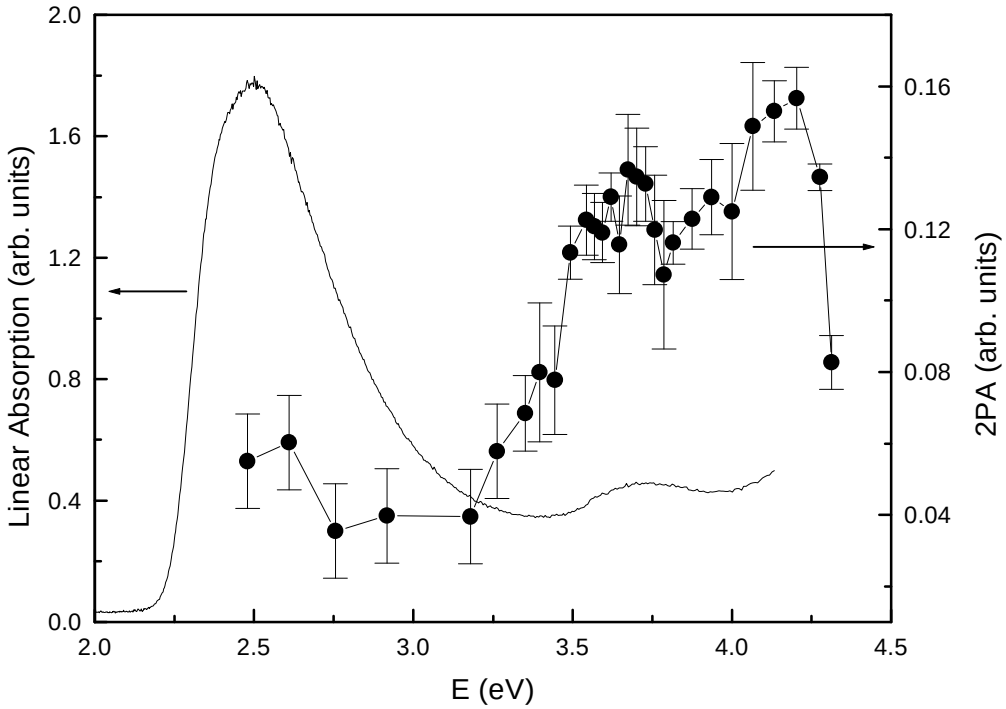

Figure 2: Linear and degenerated 2PA spectra of Meh-PPV.

Conclusions

In this work we presented the degenerated two photon absorption spectrum in a MeH-PPV chloroform solution. A strong 2PA band was observed away from the fundamental linear absorption band, as expected. However, the 2PA band we have encountered appear in a different position from previous result found in the literature. This results is probably due to the pulse duration time scale, which in our case does not lead to excited state absorption.

Acknowledgements

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