A study of the influence of dimethylamine group on acetamide-chalcone derivatives: Fluorescence turn-on and 2-photon absorption enhancement

*André Gasparotto Pelosi[1], Eli Silveira-Alves Jr[2], Leandro Henrique Zucolotto Cocca[1,2], João Victor Valverde[1], Guilherme Roberto Oliveira[2], Daniel Luiz da Silva[3], Leonardo De Boni[1], Pablo José Gonçalves[2,3], and Cleber Renato Mendonca[3]

[1]São Carlos Institute of Physics, University of São Paulo, São Carlos, 13566-590, SP, Brazil ; [2]Institute of Chemistry, Federal University of Goiás, Goiânia, 74690-900, GO, Brazil; [3]Department of Natural Sciences, Mathematics and Education, Federal University of São Carlos, Araras, 13604-900, SP, Brazil; [4]Institute of Physics, Federal University of Goiás, Goiânia, 74690-900, GO, Brazil

Chalcone backbones are currently used for photonic applications own their versatile synthesis and good optical response allowing explore the second and third-order susceptibility effects of these compounds, such as second harmonic generation and multiphoton absorption. In addition, when suitable peripherical groups are attached to the chalcone backbone, a strong fluorescence could be induced [1], permitting studies related to DNA or metal ion detection [2]. Moreover, if the induced fluorescence can be achieved by multiphoton excitation, applications such fluorescence microscopy can be aimed. It is widely known that multiphoton excitation has advantages over single photon one, owing to the excitation in the therapeutic window, for instance. Considering the importance of these compounds, in this work it was developed a linear and a nonlinear optical investigation of the influence of different electron-withdrawing (Br and NO_2) and donating (CH_3, $CHOCH_3$, $CHOCH_2CH_3$, and $N(CH_3)_2$) groups in eight acetoamide chalcone backbone. The molar absorption (1PA) and two-photon absorption cross-section (2PA) spectra were recorded for all compounds, covering the main spectral region of interest. Results of 1PA and 2PA revealed two-excited states in which the lower energy one displayed more influence depending on the peripherical group attached to the backbone. It is worth highlighting that the addition of dimethylamine group led to an increase of six-fold in the value of 2PA at the lower energy band. To better understand 2PA results, the Sum Over Essential State (SOES) [3] approach was applied together with Quantum Chemistry Calculations (QCCs). Regarding the fluorescent compound, with the dimethylamine group, additional measurements were made, such as fluorescence emission, fluorescence anisotropy, solvatochromism, fluorescence quantum yields for different solvents and multi-photon excited fluorescence. Results showed that the higher fluorescence quantum yields were achieved in dimethylformamide (DMF) solution (81%), and in dymethylsulfoxide (DMSO) solution a value of 71% was observed. Regarding the multiphoton-excited fluorescence, it was possible to record a fluorescence induced through 2 and 3 photons excitation at 900nm and 1190nm, respectively.

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