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Tesis: **"STUDY OF THE DYNAMICS OF EXCITED SPECIES IN ORGANIC SEMICONDUCTORS IMPLEMENTED IN SOLAR CELLS AND LASERS"**

Resumen:

Recently new organic materials have been developed to be used as photovoltaic devices (OPVs) and laser systems. To optimize the operation of these devices and to make viable their potential commercialization, it is necessary to have a detailed knowledge of the processes that determine the efficiency of organic materials and which are of interest for the work that is presented here are: photogeneration and transport of excitons, excited species dynamics, luminescence, stimulated emission and optical gain. In the present work, the photophysical properties of new polymers synthesized by Mexican research groups have been studied. In recent years, they have dedicated their efforts to the design and synthesis of new materials and their implementation in photonic and opto-electronic applications. In particular, this dissertation focuses on the study of polymers derived from thiophene with photovoltaic properties as well as a highly luminous and optical gain of a fluorene derivative polymer.

The first part of this work contemplates the analysis of the photophysics of a series of four non-regiorregular polythiophenes (denoted as P1-P4) that have been used in the active layer of OPVs. The motivation to study these polymers lies in being able to combine them with molecules of low molecular weight that allow to enhance their photovoltaic properties. In particular, in the P1-P4 polymers an increase in photovoltaic conversion efficiency of a factor of two was observed when doped with the molecule (6-nitro-3- (E) -3- (4-dimethylaminophenyl) alidene) -2,3-dihydrobenzo [d] [1,3,2] oxazaborol) derivative of Boron (M1). The purpose of the study is to elucidate the mechanisms responsible for the increase in efficiency, potentially being able to implement them in other systems containing low-cost non-regiorregular polymers. The analysis of the active layer by means of the transient absorption technique (TA) shows that the presence of M1 is able to increase the life time of the excited species in the polythiophene once it avoids The transit of the excited species on the polaronic band has been possible to conclude that the presence of M1 causes a greater density of species with the possibility of dissociating in free loads, thus contributing to the observed increase in the conversion efficiency for these devices.

The second part of this work contemplates the analysis of a cross-conjugated polymer based on the 4,7-bis [2-(9,9-dimethyl) fluorenyl] benzo [1,2,5] thiadiazole monomer. The polymer is denoted as PF-1 and in previous studies it has been shown to be a good semiconductor, which, when excited, generates radiative decay channels with an efficiency of almost 100%. Another aspect that makes this polymer extremely attractive is that it retains its optical properties when passing from liquid phase (solution) to the solid phase (thin films and nanostructures). During its study parameters such as laser threshold, emission wavelength and tenability, stimulated emission cross section and fluorescence life time were determined. The results show that the

characteristics of PF-1 pumped by a photon are comparable with the widely used laser dye rhodamine 6G, positioning the PF-1 polymer as a possible candidate for lasing applications. The results obtained for the PF-1 polymer coupled with its excellent two-photon excitation cross-section (high non-linear absorption of two photons) generate an interesting picture to implement solid state lasers that can be excited with near-infrared optical energies.

Our results undoubtedly acquire relevance in the context of the new advances that have been reported in the literature regarding new platforms for both OPVs and active organic lasers.