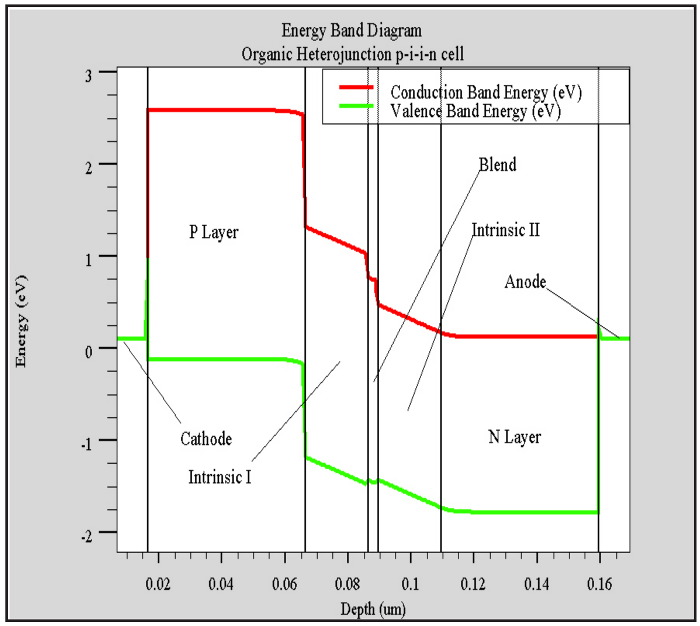
Organic Solar

ORGANIC SOLAR CELL AND PHOTODETECTOR SIMULATOR

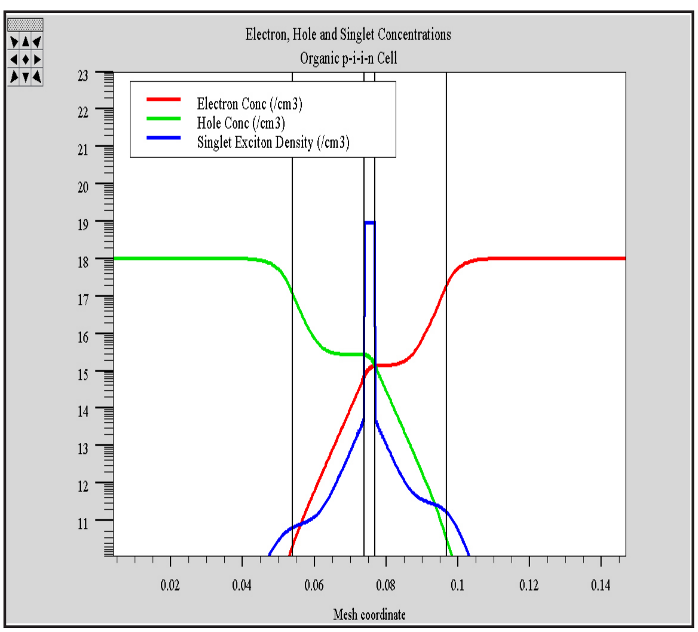
The Organic Solar module enables ATLAS to simulate the electrical and optical properties of organic solar cell devices, photodetectors and image sensors. Organic Solar is integrated into the ATLAS framework and allows the steady-state, transient and AC simulation of the electrical and optical behavior of photovoltaic organic devices. The exciton densities, diffusion, generation/recombination and dissociation characteristics can all be simulated.

Features

- Raytrace optical stimulus model
- Transfer Matrix Method (TMM) optical stimulus model
- Simulates solar spectrum characteristics
- Spectral response simulation
- Photo-generation of excitons
- Organic defect Density Of States (DOS) models
- Poole-Frenkel and hopping mobility models
- Langevin recombination model
- Coupled singlet and triplet exciton density continuity equations
- Exciton generation, diffusion, lifetime and quenching effects
- Doping specific exciton density calculation
- User definable exciton parameters such as diffusion length and lifetime
- User definable singlet-to-triplet exciton generation rate
- Steady state, transient and AC analysis



Band diagram of zero bias organic heterojunction p-i-i-n solar cell. Each region adopts various characteristics of the associated organic material including band gap, charged carrier mobilities, excitonic recombination and dissociation component rates, absorption characteristics etc. User may modify all parameter defaults to calibrate to measurement. Some commonly used materials have built in default values.



This figure shows the densities of charged carriers and excitons. In this case note that the excitons are photogenerated in the blend layer and diffuse to either side. The elevated concentrations of charge carriers in the intrinsic regions are due to the generation of electron-hole pairs through dissociation of excitons.

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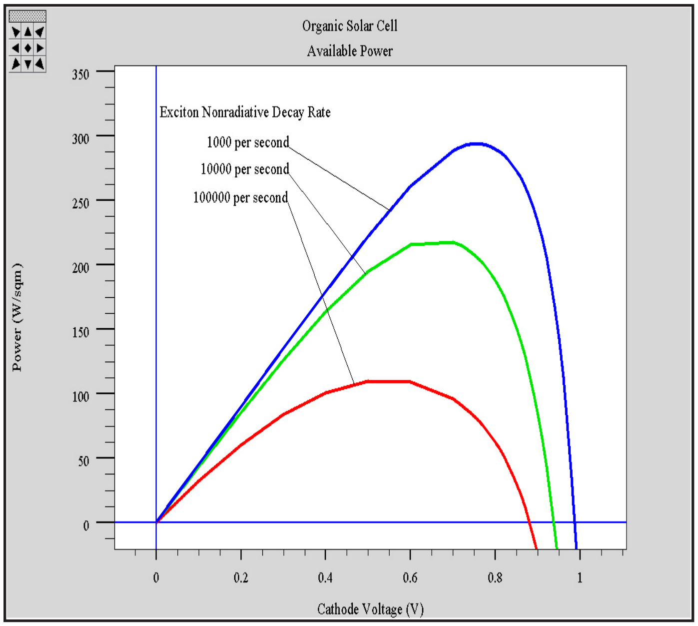
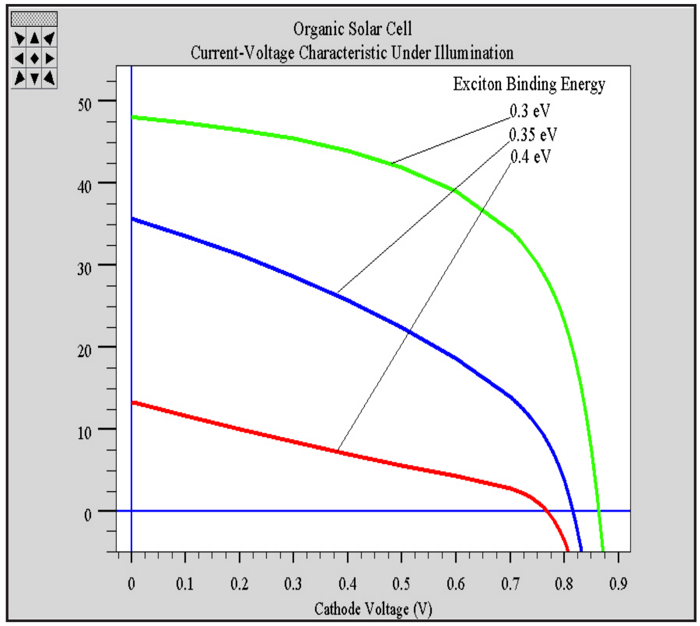
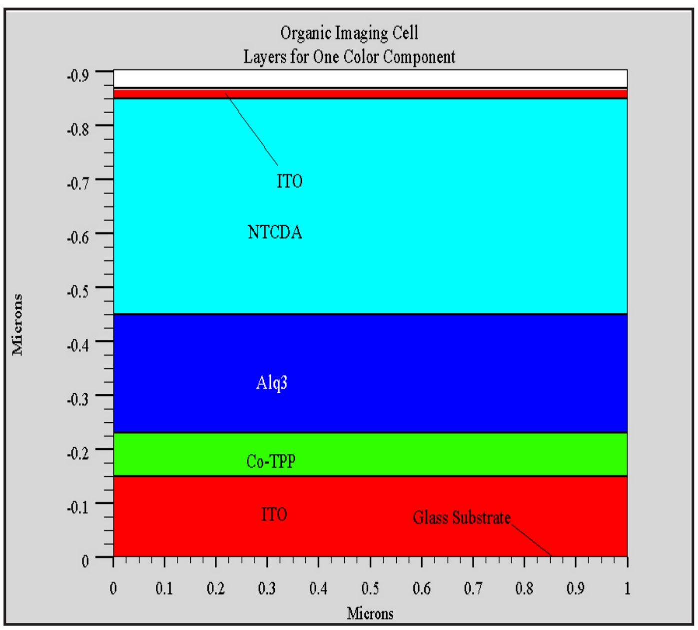


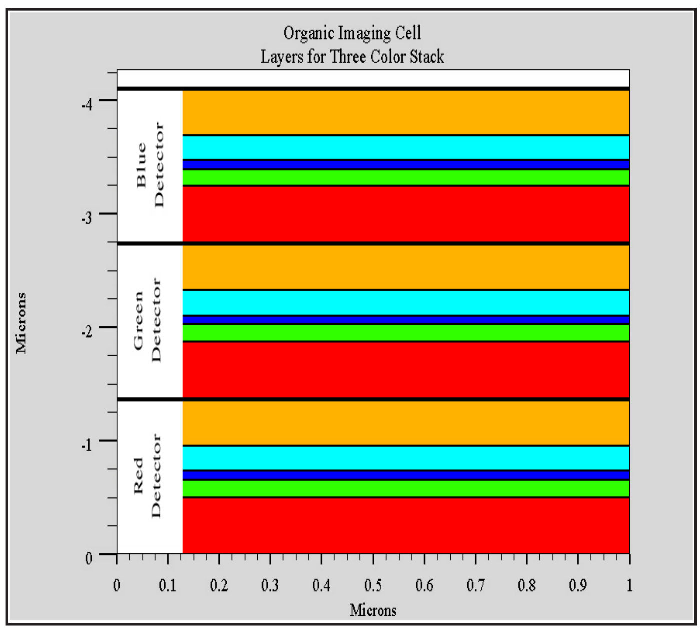
Here the solar cell power is shown to decrease with increased non-radiative decay rate of excitons. The nonradiative decay of excitons competes with exciton dissociation in the dissipation of photogenerated excitons.



This figure shows the effects of singlet binding energy on the solar cell I-V characteristic. The binding energy is introduced though the exciton dissociation rate calculation.



This figure shows a schematic of the layers in a hypothetical organic color imaging cell. Shown are the layers for one color. Color sensitivity is defined by selection of photosensitive material. In this case Cobalt TTP is selected for blue sensitivity.



Three color sensitive cells can be stacked to achieve three color sensitivity of a organic imaging cell as shown in this schematic. Ref. Seo et. al. "Color Sensors with Three Vertically Stacked Organic Photodetectors." Jpn. J.Appl. Phys., V. 46, No. 49 pp. L1240-L1242.

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HEADQUARTERS

4701 Patrick Henry Drive, Bldg. 2
Santa Clara, CA 95054 USA
Phone: 408-654-4309
Fax: 408-496-6080

JAPAN	jpsales@silvaco.com
EUROPE	eusales@silvaco.com
KOREA	krsales@silvaco.com
TAIWAN	twsales@silvaco.com
SINGAPORE	sgsales@silvaco.com

CALIFORNIA	sales@silvaco.com 408-567-1000
MASSACHUSETTS	masales@silvaco.com 978-323-7901
TEXAS	txsales@silvaco.com 512-418-2929
ARIZONA	azsales@silvaco.com 480-947-2900

WWW.SILVACO.COM

Rev. 081408_01