# NREL Highlights SCIENCE

# Charge Dynamics Breakthrough May Improve Organic-Based PV Device Efficiencies

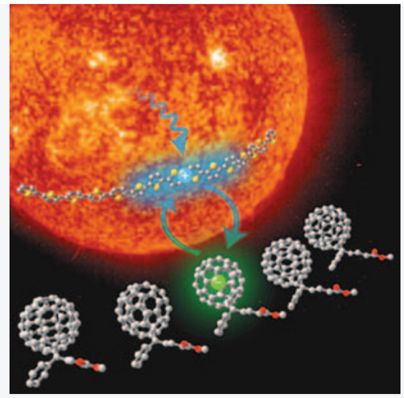
National Renewable Energy Laboratory (NREL) scientists working on molecular systems comprising the active element of organic photovoltaic (OPV) devices develop a new understanding of the processes responsible for charge generation in organic bulk heterojunctions.

OPV technologies hold great promise for solar energy because of their low cost and light weight, along with their chemically tunable electronic and optical properties. An OPV cell is a photovoltaic cell that uses organic electronics—a branch of electronics that deals with conductive organic polymers or small organic molecules for light absorption and charge transport. A heterojunction is the interface that occurs between two layers or regions of dissimilar semiconductors. It is advantageous to engineer the electronic energy bands in many solid-state device applications, including solar cells.

A longstanding question about how OPV devices work has been why the charges produced after absorption of light survive long enough to generate current within the device, given that the most widely accepted theoretical model for charge-charge interactions predicts large charge-recombination rate constants.

NREL researchers experimentally measured the charge-recombination rate of the active layer in a P3HT/PCBM OPV device and found it to be more than 1,000 times smaller than the widely accepted theoretical model.

NREL scientists also developed a novel theoretical model that correctly predicts the measured rate constant and explains the diminished charge recombination because of nanoscale phase segregation in the organic bulk heterojunction and polarization-induced reduction of the attractive forces between charges.



## Key Research Results

### The Achievement

NREL researchers have developed a new model that explains why the charge-recombination rate in OPV devices is more than 1,000 times smaller than what is widely accepted.

### Key Result

NREL research provides new insight into the fundamental role that nanoscale morphology plays in organic device applications such as solar cells.

### The Potential Impact

This work has the potential to design more efficient organic-based PV devices.

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

1617 Cole Boulevard | Golden, Colorado 80401-3305 | 303-275-3000 | www.nrel.gov

**NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.**

NREL/FS-5900-50858 • February 2011

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post consumer waste.