Finding a buckyball in photovoltaic cell

September 28 2010

Polymer-based photovoltaic cells have some real advantages compared to the currently used semiconductor-based cells. They are easy to make and the materials are cheap. The challenge is to figure out how to make efficient cells while keeping the manufacturing cost low.

One approach uses a light-absorbing polymer along with a derivative of a sixty-carbon fullerene molecule, commonly known as a buckyball. For maximum efficiency, the two materials must be present in thin layers near opposite electrodes but most analytical methods cannot distinguish between polymer and the buckyball well enough to characterize the plastic solar cell film.

New research reported in the Journal of Chemical Physics describes a technique that analyzes the reflection of neutrons to locate the buckyballs within the composite material.

"Neutron scattering is not a new technique but it has yet to be widely applied to this class of materials," says researcher Brian Kirby of the National Institute of Standards and Technology. "With this paper, we are providing an instruction book for researchers who want to use neutrons to study polymer photovoltaics."

He points out that while neutron scattering requires a reactor or particle accelerator - not typical lab equipment - scattering facilities are widely available to industrial and academic users.

Because both the polymer and the buckyball are composed mostly of

carbon and their locations must be defined within a few nanometers, standard techniques have not provided sufficient resolution to describe the location of the buckyballs. As a result, much of the research on organic solar cells has been a trial and error process. Neutrons happen to interact with the polymer and the buckyball derivative very differently, leading to a sharp contrast.

"Our goal is more effective research on photovoltaic devices," says researcher Jon Kiel of the University of Delaware. "Using this technique, we have confirmed that particles are not distributed in the ideal way and have shown how to evaluate the distribution in new materials."

More information: The article, "Phase-sensitive neutron reflectometry measurements applied in the study of photovoltaic films" by J. W. Kiel, M. E. Mackay, B. J. Kirby, B. B. Maranville and C. F. Majkrzak is published in The Journal of Chemical Physics. link.aip.org/link/jcpsa6/v133/i7/p074902/s1

Provided by American Institute of Physics