Researchers observe nanoscale charge transport in bulk heterojunction solar cells

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(PhysOrg.com) -- Researchers in the CNST have used photoconductive atomic force microscopy (PCAFM) to characterize the nanoscale structure of organic photovoltaic (OPV) materials, and have performed a careful assessment of the strengths and weaknesses of this technique.

By varying the device geometry and the AFM tip material, the researchers clarified how the local nanoscale experimental and material factors affect the overall OPV efficiency. OPVs consist of two types of organic molecules, electron donors and electron acceptors. When illuminated by sunlight, the photoexcited electron-hole pairs separate at the interface between the donors and acceptors.

The separated charges migrate to different contacts, generating an electrical current. The most efficient OPV materials have a homogeneous mixture of donor and acceptor molecules throughout the entire structure, with charge separation occurring throughout the entire volume. Unfortunately, the photoexcited charge must pass through a highly disordered environment, which inhibits their mobility, increases recombination, decreases efficiency, and hampers the material's ability to produce electricity.

The efficiency is strongly dependent on the material morphology, making measurements that correlate nanoscale structure with performance crucial to understanding and improving OPVs. Because PCAFM is now widely used to characterize OPV materials, the CNST researchers expect their assessment of this measurement technique to be

important to other researchers in the field, who must consider both its strengths and pitfalls.

More information: Imaging of nanoscale charge transport in bulk heterojunction solar cells, B. H. Hamadani, et al., *Journal of Applied Physics* 109, 124501 (2011).

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