Novel concept of organic photovoltaic cell

Demonstration of photoelectric conversion at near-infrared region (wavelength > 1 μm)

We have substantiated an organic photovoltaic cell (OPC) based on a novel concept where optical absorption due to the charge-transfer between different organic molecules is utilized. Research and development of OPC technologies have currently been conducted worldwide because the technologies are expected to realize light-weight, flexible photovoltaic sheets. In this study, we designed and fabricated a prototypical OPC using a molecular compound composed of two different kinds of organic molecules. It was found that the device presents a photovoltaic effect due to the irradiation of near-infrared light whose wavelength is longer than 1 μm, although such a photoelectric conversion of near-infrared light has been very difficult in conventional OPCs. Furthermore, the lifetime and the diffusion length of excitons or charge carriers in the device were found to be three orders of magnitude longer than those of the conventional OPCs. Based on the concept, we can expect to realize the more efficient conversion from light energy to electric energy.

Tatsuo HASEGAWA
t-hasegawa@aist.go.jp

Jun'ya TSUTSUMI
junya.tsutsumi@aist.go.jp

Flexible Electronics Research Center

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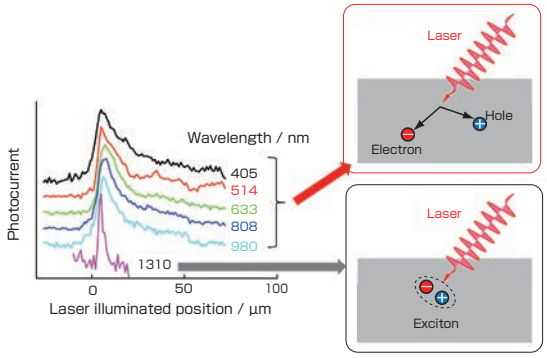

Decay profiles of high-resolution laser-beam-induced current at different excitation wavelengths

Organic materials that liquefy upon irradiation by light

Novel reusable photoresponsive materials

We have developed novel solid organic materials that liquefy upon photo-irradiation. The new materials have a reversible property – they resolidify upon heating – in contrast to conventional light-sensitive polymers. This reversible switching property is induced by photoisomerization of azobenzene. Generally, isomerization of azobenzene and its derivatives readily occurs in solutions, but rarely takes place in their solid state. However, newly synthesized macrocyclic azobenzenes with flexible alkoxy chains exhibit crystal-to-isotropic phase transitions upon irradiation by light. As far as we know, this is the first report of a solid-to-liquid phase transition achieved by photoisomerization rather than heating. Our materials have potential applications to photoresists, photoresponsive adhesives, and other photoresponsive materials.

Yasuo NORIKANE

Electronics and Photonics Research Institute

y-norikane@aist.go.jp

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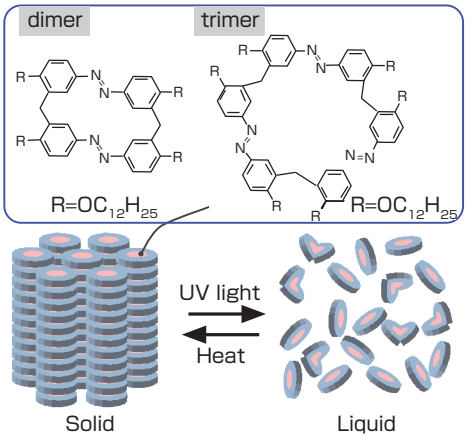

Chemical structures of the two newly developed organic compounds (top) and schematic diagram of the phase transitions of the compounds (bottom).