

Novel low temperature laser processing of silicon for hybrid organic/inorganic solar cells

Researchers at the Advanced Technology Institute (ATI) at the University of Surrey have reported a new technique to UV laser processing of thin film silicon for applications such as display control circuits and solar cells, which could lead to device performances at lower costs.

The improvements are achieved with a new pulse profile for crystallisation of amorphous silicon to nanocrystalline as reported in the April issue of Applied Physics Letters (90, 171912). Lead investigator Dr Damitha Adikaari comments: "The use of a modified laser pulse shape results in more efficient transformation of amorphous silicon into its crystalline form, with significant control of surface roughness allowing for higher degree of control of design parameters."

The enhanced understanding of effects of the pulse profile on the texture of silicon films has allowed the investigators to fabricate efficient organic/inorganic hybrid solar cells, with the highest reported efficiency for nanocrystalline silicon and the type of polymer used (MEH-PPV). (Applied Physics letters, 90, 203514) Dr Adikaari further states that "the cells were initially fabricated to help us understand nanocrystalline inorganic/organic interfaces, made with laser textured nanocrystalline silicon and spin-cast MEH-PPV. However, they result in impressive photocurrents, where the bulk of the photo-generation is believed to be from the nanocrystalline silicon layer."

The laser texturing of amorphous silicon has also been used to prove another concept to increase the surface area of organic photovoltaics while keeping the device thickness to a minimum. In a subsequent article to be published in Applied Physics Letters, the researchers report nano-imprinted organic cells with a laser textured stamp. The lead investigator Mr Nanditha Dissanayake states "the imprinting process results in a five-fold increase in photo-current, purely due to the surface area increase which increases the collection efficiency of the photo-generated carriers."

The Director of the ATI, Professor Ravi Silva, who also heads the Nano Electronics Centre where the work was carried out, comments: "The fundamental understanding we have gained in nano-texturing of amorphous silicon has led ATI researchers to improve charge extraction of organic/inorganic hybrid devices, which is giving rise to some exciting device physics. These nano-engineered devices promise a lot of potential for large scale organic/inorganic photovoltaics."

Source: University of Surrey

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