MAR08-2007-001240

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Novel ultra high efficiency concepts in solar cells[1]

ANTONIO LUQUE, Universidad Politecnica de Madrid

The limit efficiency of conventional solar cells is about 45% as obtained in 1960 by Shokley and Queisser. Besides the multijuntion solar cells, other novel concepts have been proposed in the last years with efficiency limit in the range of 85%. They will be reviewed now. The intermediate band (IB) solar cell attempts to increase the photocurrent of a solar cell without reducing the voltage. For it an electronic band is fabricated in the mid of the bandgap, the IB, so that electron hole pairs are created by the absorption of two sub-band-gap photons using the IB as a relay. Furthermore, the preservation of the voltage requires that a new quasi Fermi level appears in the IB, different to those in the valence band (VB) and in the conduction band (CB). So far IB materials have been produced, either using the confined states of quantum dots or by alloys. The basic principles, both of electron hole creation by double photon absorption and the appearance of a third quasi Fermi level have been experimentally proven. The principle of the multiple generation solar cells is based on the creation of several electron-hole pairs by photons whose energy is well above the bandgap. So far up to seven electro-hole pairs have been experimentally proven from a single photon in structures with PbSe quantum dots. Solar cells based on the two preceding concepts have been fabricated although with performances still low. In the hot carrier solar cells what is intended is to recover the energy of gas of electrons excited by the flux of photons before they thermalise with the lattice. Basic requirements of this device are being understood. They require a medium in which electrons and phonons are very decoupled and narrow contacts for extraction the hot electrons. The role of the quantum dots may be important. Experimental research in this field is about to start.

[1]This work has been supported by the European Commission within the project FULLSPECTUM (SES6-CT-2003-502620) and the projects NUMANCIA (S-0505/ENE/000310) funded by the Comunidad de Madrid and GENESIS-FV (CSD2006-00004) funded by the Spanish National Prog