Predicted photoreflectance signatures on QD selective contacts for hot carrier solar cells

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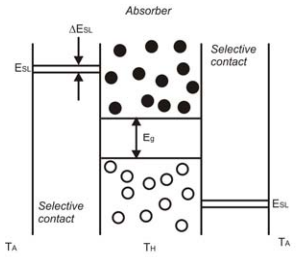
Introduction

The CO_2 emission of our present energy transformation processes, based mainly on burning fossil fuels, is possibly the main cause of global climatic change.

The photovoltaic conversion of solar energy is a clean way of producing which for sustainability should (and most probably will) become a major source of electricity

The sun is a huge resource but relatively diluted and it is reasonable to expect that only high efficiency extraction can be cost effective for mass exploitation [Luq08]. New concepts are neccessary → such as hot carrier solar cells

Hot carrier solar cell



Ideal effciency: 85%

[Wür97]

Slowing the thermallisation of photogenerated e-'s and h+'s in the absorber material

Key

Keep the carriers hot without heating the lattice.

Extraction of the hot carriers to external selective contacts where the excess of carrier energy is not lost.

Key

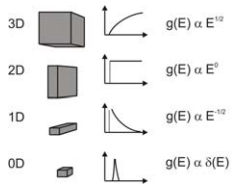
*Achieve a rapid **extraction** of carriers throught a **narrow energy range**.*

QD based selective contacts

Narrow energy range

Tipical DOS for QD systems

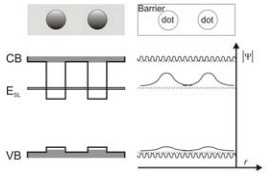
Isolation of dot material ground state needed. Similar to other high efficiency QD solar cell concept [Mar06].



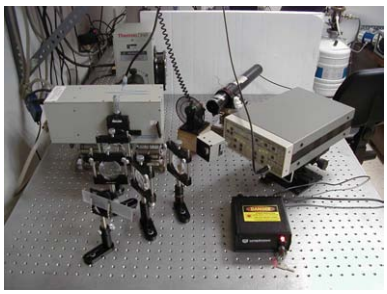
Extraction

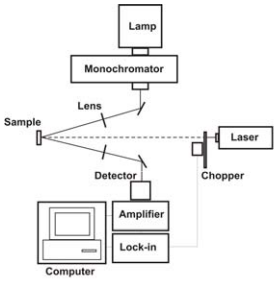
More than one QD single layer could be needed in order to increase conductivity in selective contacts.

Overlapping of QDs wavefunctions could be needed in order to form a evacuation channel (band)



Photoreflectance characterization





PR is a spectroscopy technique based on analysing the optical response of a material under a periodical light perturbation [Car69].

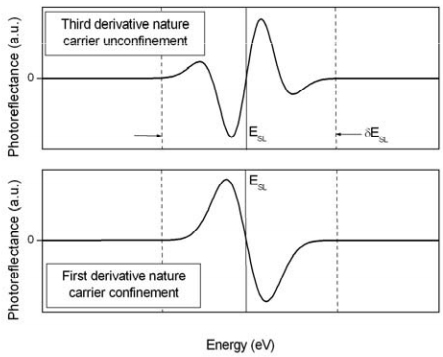
By PR we can analyse the band diagram of the QD based selective contacts.

Fitting procedures on PR can inform about carrier confinement [Can08]:

-Third derivative nature of PR features expected for unconfined systems.

-First derivative nature of PR features expected for confined systems.

In order to create a QD based selective contacts, the QDs should provide a set of non-confined carrier states, which should be evidenced by a third derivative PR feature.



Real dot-barrier configurations for selective contacts will show more than one isolated evacuation channel → Fit the theory?

Conclusions

PR is shown to be a powerful spectroscopy method in order to characterize the hot carrier solar cell selective contacts.

Selective contacts based on QDs will have particular signatures on PR such as third derivative nature.

[Luq08] *Electronic Letters* 31st July 2008 Vol. 44 No. 16.

[Wür97] *Solar Energy Materials and Solar Cells* 46 (1997) 43-52.

[Mar06] *Thin Solid Films* 511–512 (2006) 638–644.

[Car69] M. Cardona, *"Modulation Spectroscopy"*, 1969 Academic Press NY

[Can08] 1CV.1.21, *2*3rd Eur. Phot. Sol. Ener. Conf. Valencia (Spain) 2008.

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