Photocurrent properties of junctions with single PbSe quantum dots

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Understanding charge transport in photoexcited coloidal quantum dot (QD) solids is key to their applications in optoelectronic devices. Despite recent progress towards this end, the physics which governs the photoconductance properties of these structures is surprisingly still unclear and elusive.
One possible route to facilitate better understanding of these systems is, instead of performing photoconductance measurements of large ensemble of QDs, to measure individual QDs located within nano-scale gaps between two metal leads. While the conductance properties of such junctions has been studied quite extensively, the study of their photoconductance properties is surprisingly very scarce.
Here I will report of low-temperature photocurrent measurements of nano-scale junctions with single PbSe QDs.
Several novel effects in the dc-current photoresponse of these junctions will be discussed such as the destruction of photocurrent at specific voltage bias values and photo-induced gating.
Analysis of their time-resolved response as well as their noise properties reveals further information on the mechanisms that govern their photoconductance behavior.
The presented results are argued to be complimentary to the information gained by photoluminescence measurements of individual QDs.

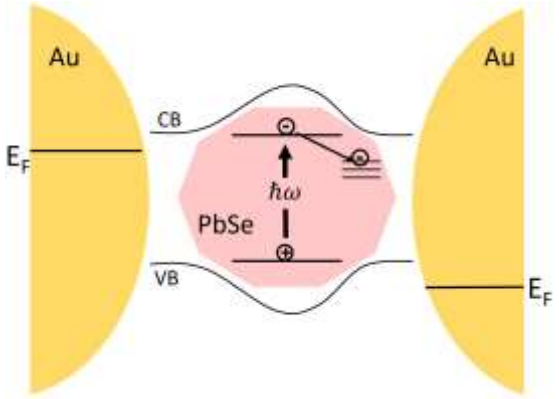

Figure 1: Schematics of a PbSe quantum dot within a nano-scale junction with Au leads. Also shown are the energy levels that are relevant for the interpretation of the photoconductance properties of such a junction.