

Physics Journal Club Meeting

CdSe/ β -Pb_xV₂O₅ heterostructures: Role of lone pairs in achieving directional charge transfer

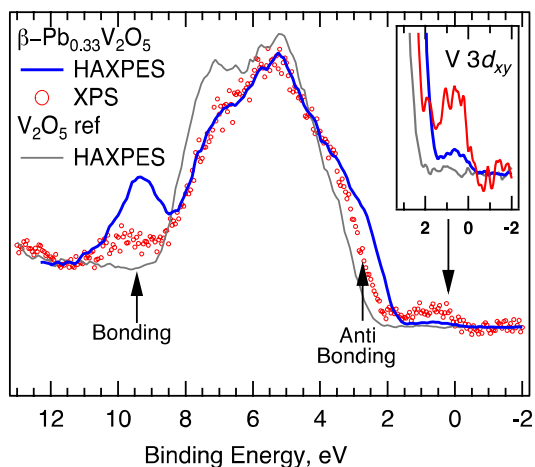
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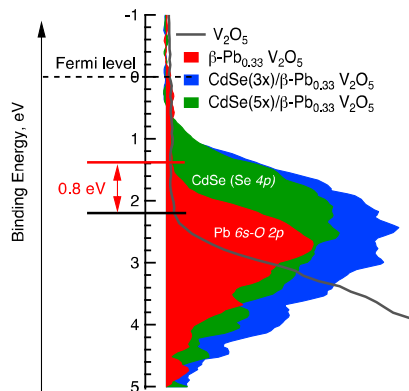
Vanadium oxide bronzes ($M_xV_2O_5$) can accommodate a range of cations e.g Li^+ , Na^+ , Ag^+ and Pb^{2+} . The resultant materials can exhibit varying properties such as metal insulator transitions, pressure induced superconductivity and directional charge transfer depending on the transition metal cation (M), cation value (x) and synthesis conditions. Nanostructuring in particular has revealed new properties due to their defect and strain free nature. Hydrothermally synthesized β -Pb_xV₂O₅ nanowires, for example, exhibit metal-insulator transitions that were not present in its bulk counterpart. Furthermore, first principle calculations predicted an additional mid-gap state present in β -Pb_xV₂O₅ derived from stereoactive lone-pairs that facilitates this transition. This has led to interfacing β -Pb_xV₂O₅ with CdSe to access these mid-gap states for light harvesting applications.

In this talk, I will show how we have confirmed this predicted stereoactive lone pair induced mid-gap states in pristine β -Pb_xV₂O₅ nanowires. Additionally, we have interfaced β -Pb_xV₂O₅ with CdSe quantum dots (QDs) for application as a photocathode. We observe an overlap of the mid-gap states with the valence band edge of CdSe. In this architecture, both electron and hole transfer are facilitated with transitions from photoexcited CdSe QDs to the conduction band (electron transfer) and mid-gap states of the β -Pb_xV₂O₅ nanowires (hole transfer). In contrast, only electron transfer is achieved when CdSe QDs are interfaced with V₂O₅ nanowires.

(a) Mid-gap states derived from stereoactive lone pairs



(b) Overlapping mid-gap states with CdSe QDs valence band



Friday, September 30, 2016

Science II Room 144

Pizza @ Noon

Presentation @ 12:15

There will be a sign-in sheet for all attendees to sign.