Energy level alignment of quasi-2D perovskite

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$MAPbI_3$ perovskite, which is one of the most popular materials for solar cells, has issues associated with long-term stability against moisture, heat, and UV-light.[1] In this regard, The high stability of 2D and quasi-2D perovskites have attracted much attention recently.[2] In the perovskite solar cell, Energy level alignment (ELA) determines the charge injection, transfer, and recombination at the interfaces and considerably affects the device performance.[3] Thus, understanding the ELA at various interfaces is crucial to fabricate high performance of perovskite solar cell. Yet, interface ELA between quasi-2D perovskite and related charge transport materials has not been determined comprehensively.

Ultraviolet photoelectron (UPS) and low-energy inverse photoelectron (LEIPS) are powerful techniques[3–5]that provide both occupied and unoccupied electronic states of the solids. In this work, we applied the UPS and LEIPS to elucidate the interface ELAs for both occupied and unoccupied levels between quasi-2D perovskite (R= $C_6H_5CH_3CH_2NH_3$ (PEA), A= CH_3NH_3, B= Pb and X= I) and electron transport layer, C60 and hole transport layer, Spiro-OMeTAD.

Figure 1 (top) displays the energy level diagram of Spiro-OMeTAD on both 3D ($MAPbI_3$) and quasi-2D perovskites. We found that both ELAs are similar to each other, and preferential to the hole collection and the electron blocking from the 3D and quasi-2D perovskites to the Spiro-OMeTAD. Similar phenomenon is found in C60 (Figure 1 bottom) that both ELAs on 3D and quasi-2D perovskites are similar and C60 can be a good candidate for electron collection and hole blocking layer. We claim that PEA does not affect the electronic structure of $MAPbI_3$ while passivating the surface.

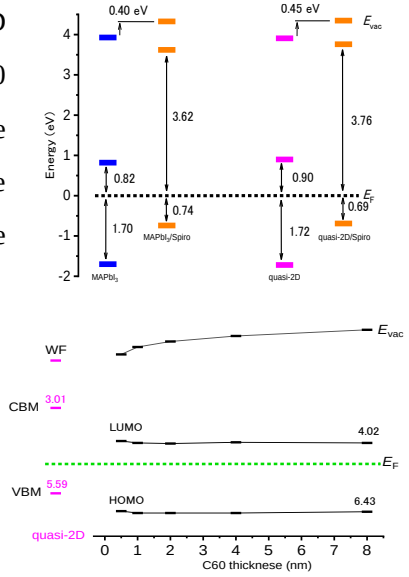

Fig.1 energy diagrams of Spiro-OMeTAD (top) and C60 (bottom)

References

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