MIB-SOLAR

Centro Milano Bicocca per lo Studio di Materiali,

Processi e Dispositivi per l'Energia Solare

Dipartimento di Scienza dei Materiali
Università di Milano-Bicocca,
Via Cozzi 55, I-20125, Milano

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Department of Materials Science

U5 1st Floor -Seminar room

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Quasi Fermi level splitting of Cu-poor and Cu-rich $CuInS_2$ absorber layers

$Cu(In,Ga)S_2$-based solar cells are interesting tandem partners for Si or chalcopyrite solar cells, but suffer from a low open circuit voltage. Recently, record efficiencies have been achieved by using higher growth temperatures for the absorber. To gain further insight, the study of the structural and electronic quality of only the $CuInS_2$ absorber is essential as recombination mechanisms at the interface of absorber and buffer layer in the device are excluded. We have studied the growth temperature dependence of the absorber quality itself by investigating electronic and structural properties. We show that the quasi Fermi level splitting, which indicates the maximum open circuit voltage an absorber is capable of, increases with higher growth temperature. The quasi Fermi level splitting is limited by a deep defect and its concentration decreases with higher growth temperature and is less prominent in Cu-rich films. Thus, we demonstrate that the open circuit voltage of $CuInS_2$-based solar cells can be limited to below 850 mV by the absorber, independent of the interface. In contrast to the changes in the electronic properties, the structural properties are rather independent of temperature within the range investigated but are significantly influenced by the composition.