Apparent bandgap lowering in SILAR CdS

Elena Rabinovich and Gary Hodes
Dept. of Materials and Interfaces, Weizmann Institute of Science, Rehovot 76100, Israel

SILAR (Selective Ionic Layer and Reaction) is the solution equivalent of ALD for highly controlled deposition of semiconductor films, most commonly ultrathin (few nm – few tens nm) films. The highest efficiency cells liquid junction semiconductor sensitized solar cells to date use this method to deposit the absorber.

From the literature, it can be seen that SILAR CdS often shows a response (absorption or spectral response) that is appreciably red-shifted from that normally obtained. We have studied this phenomenon with the aim to understand the reason for the red-shift.

We find that the apparent bandgap of SILAR CdS deposited on ZnO nanorods decreases with film thickness to a value of ca. 2.15 eV (normal value = 2.4 eV). However the red-shift is due not to a change in bandgap, but rather to an unusually strong tail absorption in the CdS. The absorption coefficient of the tail (below the bandgap) is even larger than that typical of CdS in the strongly absorbing region. Made into SSSCs, the quantum efficiencies are high for very thin films but gradually decrease as the thickness increases. The combination of thin layers (because of surface area multiplication in these cells) and high absorption coefficient (which means that even thinner layer thicknesses are needed) appears to be the key for the good cells obtained from SILAR CdS.