Photochromic properties of double layer CdS/MoO_3 thin films

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The sub-stoichiometric molybdenum trioxide (layered α-MoO_3) thin films are photochromic and thermochromic and have vide applications in optical data storage and display systems. The optical absorption in these films is caused by the small-poloron hopping between two non-equivalent sites of molybdenum Mo^{5+} and Mo^{6+}.

The double layer CdS/MoO_3 systems were deposited by sequential evaporation of CdS (thermal evaporation) and MoO_3 (activated reactive evaporation) films on well-cleaned Pyrex glass substrates. The photochromic properties were studied in the spectral range 300 to 1500 nm by illuminating with a 100 W tungsten lamp at various irradiation times. The photochromic behavior was observed of both CdS/MoO_3 and $In:CdS/MoO_3$ deposited on glass to compare these double layer systems.

The irradiation produced free electrons which are trapped by anion (oxygen) vacancies by forming colour centers. The evaluated maximum colour center concentration was $1.6\times10^{17}/cm^3$ at a threshold time of 40 minutes. The photochromic behavior and hence the color centre concentration was increased by forming a double layer $glass/CdS/MoO_3$ system in which CdS and In:CdS were used as interlayer, because of the semiconducting and photosensitive characteristics of CdS. The color center concentration was found to be higher in $glass/In:CdS/MoO_3$ than the $glass/MoO_3$ and $glass/CdS/\ MoO_3$ systems. The driving force for electron transfer between CdS and MoO_3 is the relative energy difference between the conduction band of the two semiconductors. The conduction band of CdS is more negative than that of MoO_3. Hence the bottom of the conduction band for MoO_3 is lower than that of CdS favoring electron injection from photoexicited CdS to MoO_3 as shown in Fig. 1.

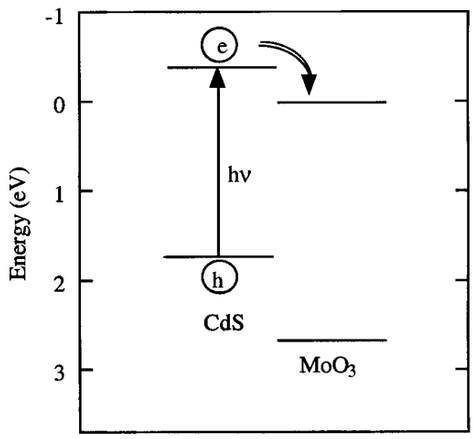

FIG. 1. Energy diagram for the CdS/MoO_3 double-layer system.