

PHOTOELECTROCHEMICAL (PEC) STUDY of the CdS|FeCl₃/FeCl₂|Pt and CdS|NaOCl/Cl₂|Pt SYSTEMS

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In a PEC system the photovoltage U_{oc} under illumination at open circuit is determined by the difference of the electrode Fermi level $E_{F,sc}$ and the redox electrolyte Fermi level $E_{F,red}$:

$$e \cdot U_{oc} = E_{F,sc} - E_{F,red} \quad (1)$$

Our recent investigations of conversion processes /1–3/ have shown that PEC systems with polycrystalline CdS photoanode behave according to Eq. (1) in the $E_{F,red}$ range from -4eV to -5eV . In this study we have investigated the conversion properties of PEC systems with electrolytes of even deeper Fermi levels, namely NaOCl/Cl₂ and FeCl₃/FeCl₂. The informations in the literature about the latter are very poor, and for the first we have not found any data.

The preparation technique of CdS films and the experimental measurements methods are described in /1–3/.

The efficiency and fill factor, estimated from power characteristics in Fig. 1, are 0.1% and 0.20, respectively for the PEC converter with NaOCl/Cl₂ redox electrolyte, these values being 0.1% and 0.25 for PEC with FeCl₃/FeCl₂. The reported data are not corrected for reflection or light absorption by the solution and therefore present real characteristic parameters of the cells operated as solar cells. The values are low due to polycrystalline structure of CdS films. For both systems the dependences of the short circuit current j_{sc} on illumination intensity I and the open circuit voltage U_{oc} on $\ln I$ are linear in agreement with theory. This is illustrated for the CdS – FeCl₃/FeCl₂ system in Fig. 2.

Fig. 3 shows the increase of U_{oc} for different illumination intensities (the numerical data beside the curves have to be read in W/m^2) caused by lowering $E_{F,red}$ (the measured $E_{F,red}$ values are indicated by vertical lines). The NaOCl/Cl₂ couple has deeper Fermi level and also higher open circuit value than the FeCl₃/FeCl₂ redox system. The results of our recent investigations with PEC systems of higher Fermi levels are also shown in this figure. It is obvious that PEC converters with CdS polycrystalline photoanode react to changes of the electrolyte Fermi levels according to Eq. (1). The exception is the PEC system with Fe²⁺ ions. The possibility to interpret the above mentioned beha-

viour by the efficient hole transfer from CdS to reduced redox species lies on the assumption that all complexes are better adsorbed at the surface than Fe^{2+} ions, which are surrounded by a strong solvation shell /4/. Adsorption, however cannot be the only dominant factor in the conversion process.

Further work, which is possible because of the low cost CdS photoanodes are used in experiments, is being carried along the lines described.

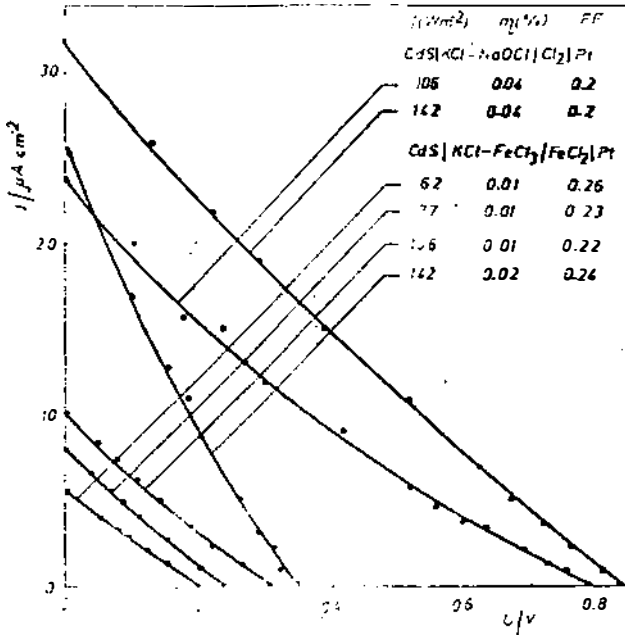


Fig. 1.

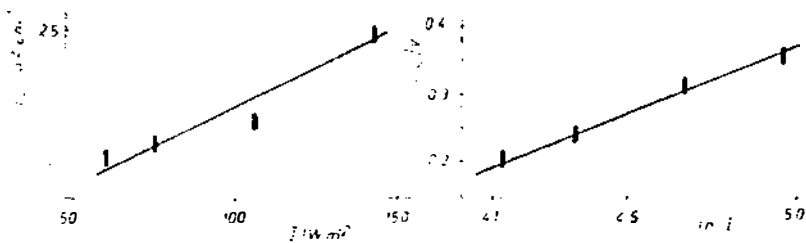


Fig. 2.

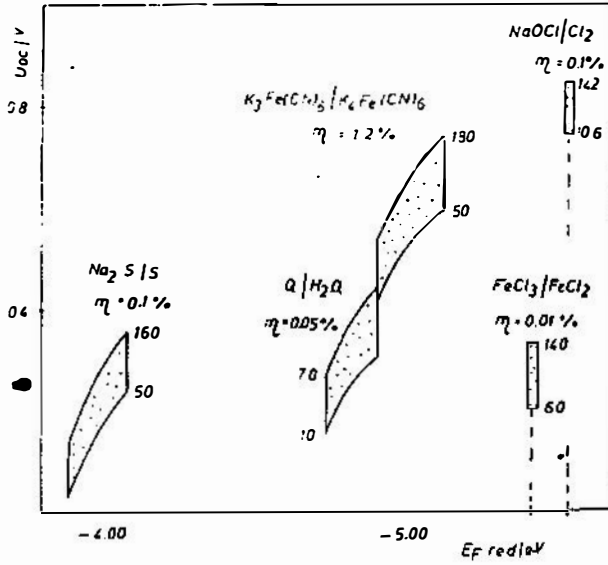


Fig. 3.

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