CIS films deposited on different flexible substrates for photovoltaic applications

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Introduction

• CIS (Cu-In-Se) has for long proved to be a material of choice for producing solar cells with high conversion effiencies (19.9 % in laboratory [1,2]);

• CIS thin films were produced so far by using various techniques on a variety of substrates

• We report here on an electrochemical procedure for depositing CIS thin films for use in photovoltaics on flexible substrates (Kapton and PET);

• Structural and morphological properties of the films are discussed, in connection with the parameters controlling the growth conditions.

Motivation

• Complex ternary semiconductor $A^{I}B^{III}C_2^{VI}$ compounds and solid solutions based on them are intensively investigated nowadays as materials showing significant potential for photovoltaic applications;

• The (electro)chemical methods used for producing CIS thin films are not expensive [3];

• The potential of chemical methods in obtaining high quality films has not yet been fully exploited [4];

• Very good stability in outdoor tests for CIS-based photovoltaic structures

Experimental

• CIS thin films have been prepared by one-step electrodeposition process from aqueous solution containing $CuSO_4$*5H_2O, $In_2(SO_4)_3$, H_2SeO_2 and gluconic acid as complexing agent;

• The substrate used as cathode was a special plastic foils (Kapton® Type HN) coated with Ni (thickness=1µm) deposited by Thermionic Vacuum Arc method;

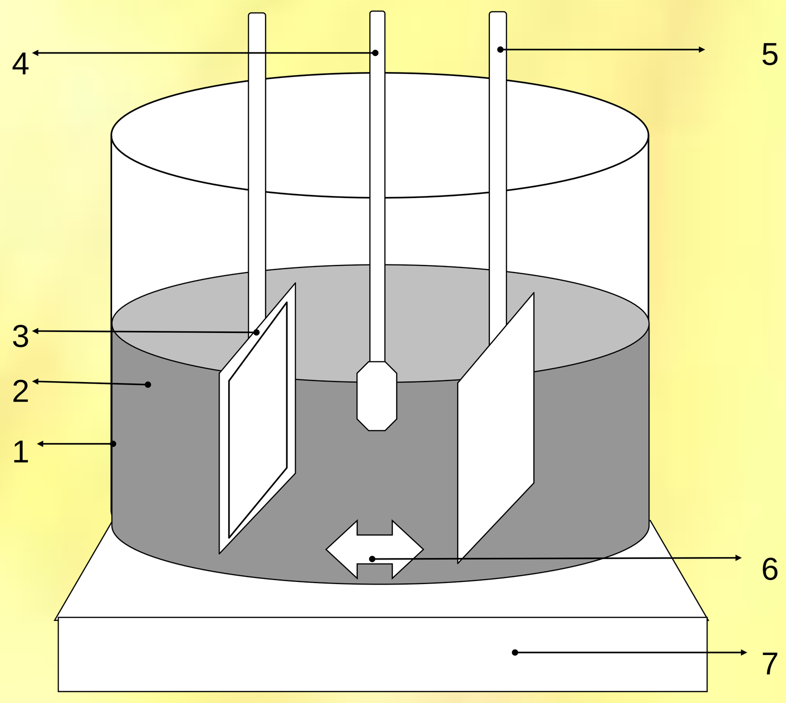
• The substrate used as cathode was plastic material foils (PET) coated with ITO with resistivity around 25-30 Ω /□

• Various deposition conditions were tested;

• The morphology of CIS thin films was investigated by SEM,

• The crystallinity of the CIS films was characterized by X-Ray Diffraction,

• Refractive index *n* and extinction coefficient *k* were measured in NIR-VIS region;

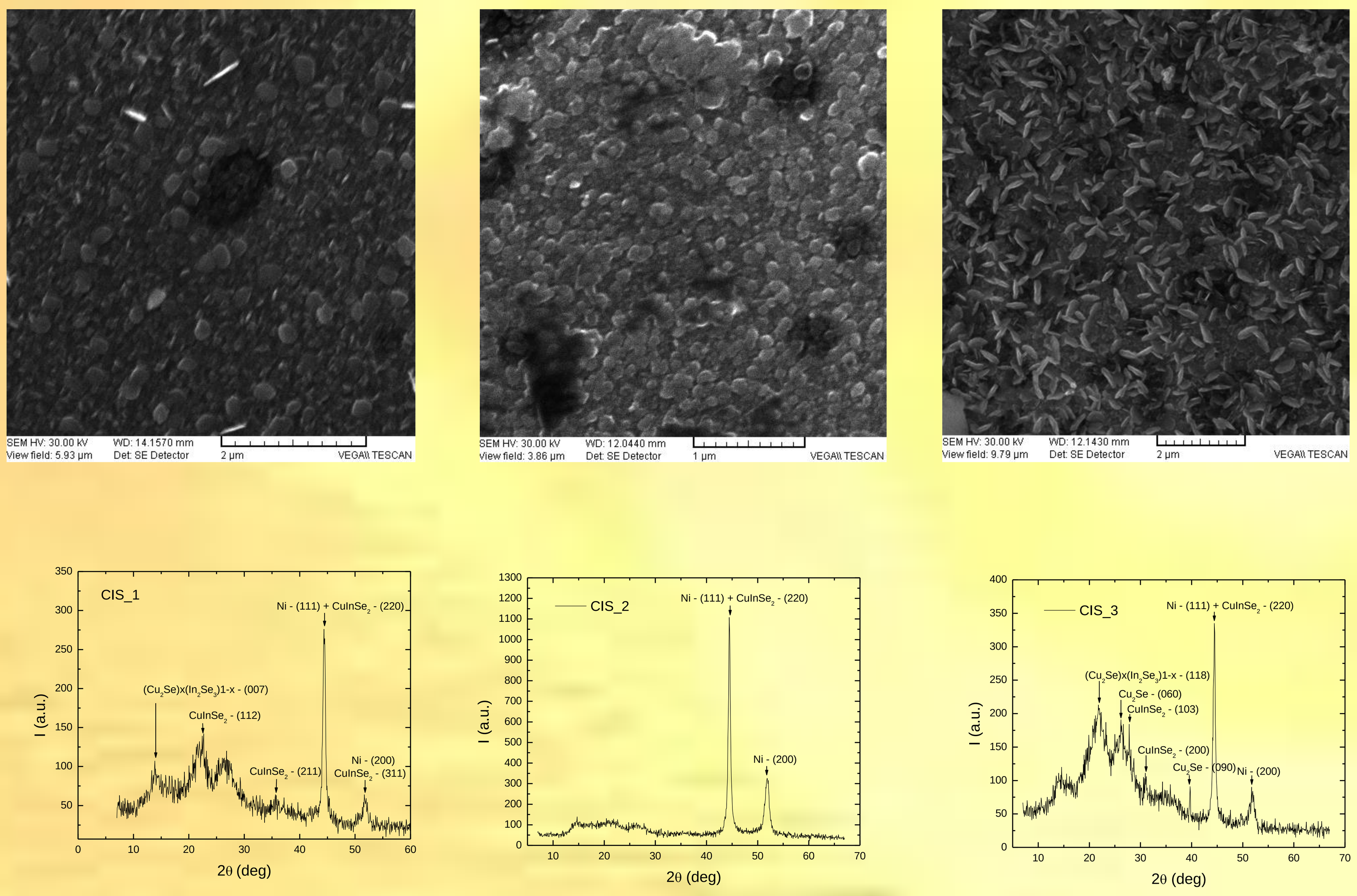


Electrodeposition experimental arrangements:

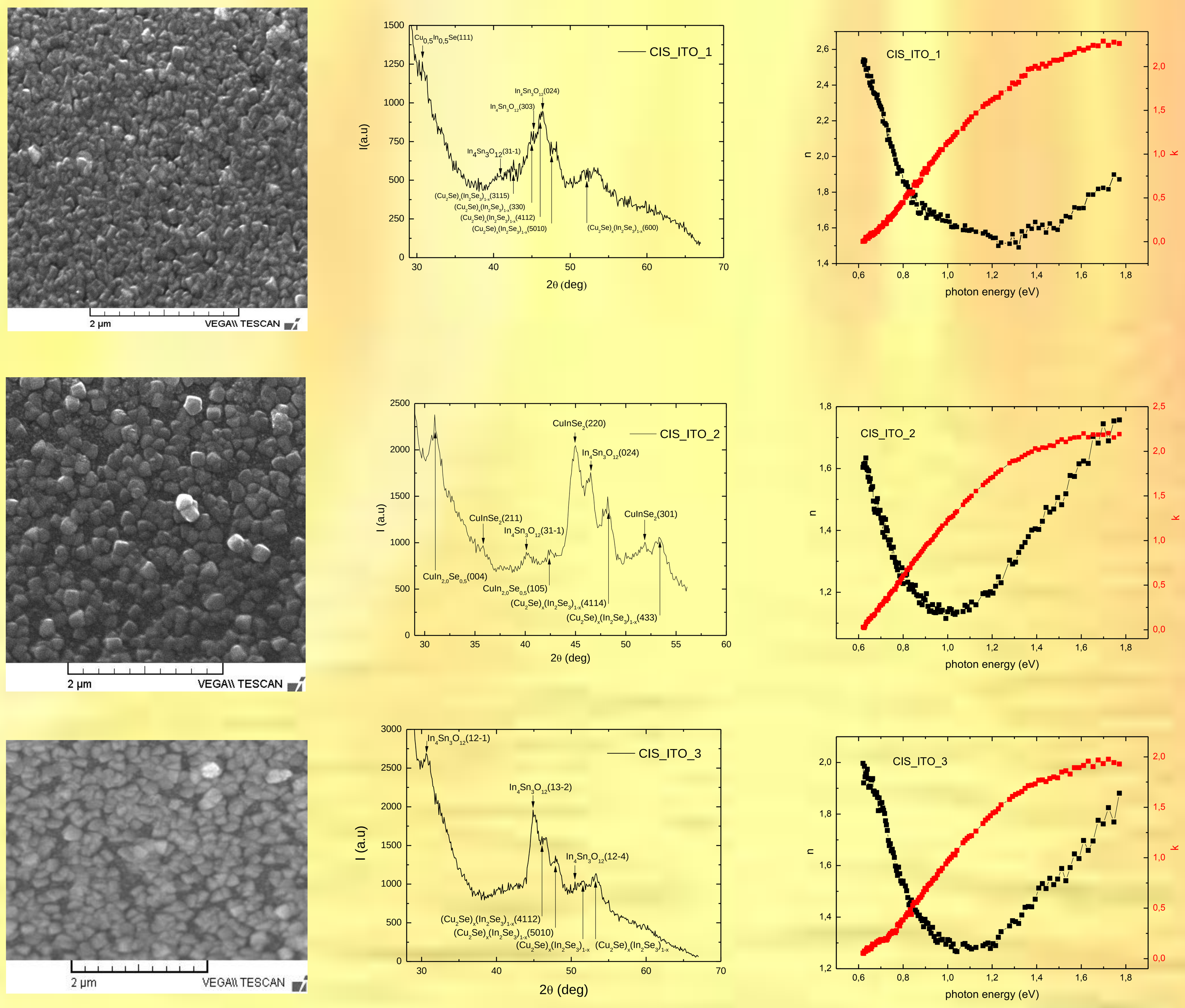
1. Electrolytic cell;
2. Electrolyte bath;
3. Cathode (kapton strip foil);
4. Reference electrode (SCE);
5. Anode (platinum plate);
6. Stirer;
7. Magnetic stirrer with heating plate.

Results and Discussion

Kapton/Ni/CIS



PET/ITO/CIS



Sample	Time (min.)	Potential (V)	Distance A-K (mm)	E_g (eV)
CIS_1	10	1.02	15	-
CIS_2	10	1.03	15	-
CIS_3	20	1.01	15	-
CIS_ITO_1	45	1.3	10	1.01
CIS_ITO_2	45	1.1	10	1
CIS_ITO_3	45	1.1	10	1.05

Experimental investigation will continue in the following directions:

- study of phases present in the electrodeposited this films,

- study mechanical properties of the thin films (adherence to Ni and ITO suport).

References

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