Structural, dielectrical, optical and electrical properties of Aloe Vera Latex and its application as a dye in solar cell

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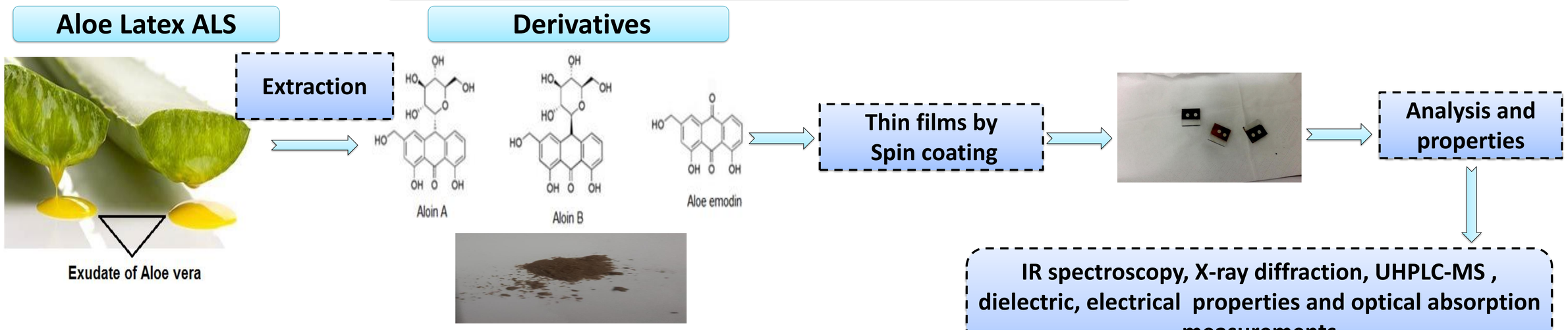
ABSTRACT

In the present study, the Aloe Latex as yellow orange Solid (ALS) collected from the leaves of Aloe Vera plant (aloe barbadensis miller) was used as a natural and cheap sensitizer thin film. The ALS powder was analysed using X-ray diffraction, UHPLC-MS and Fourier Transform Infrared (FT-IR) spectroscopy to determine the chemical composition the structural properties while the impedance spectroscopy was performed for the dielectrical properties. For the optical proprieties, UV-Vis absorption of the ALS was analyzed as thin film deposited in a glass. For a first trial, a planar heterojunction solar cell using zinc oxide (ZnO) thin film as an electron selective layer was build. The band gap was found to be 1.88 eV. The electrical properties of the investigated cell by the current–voltage (I–V) measurements showed an open circuit voltage (Voc) of 0.74 V and a great fill factor (FF) of 0.70.

EXPERIMENTAL STUDY

Methodology



Results

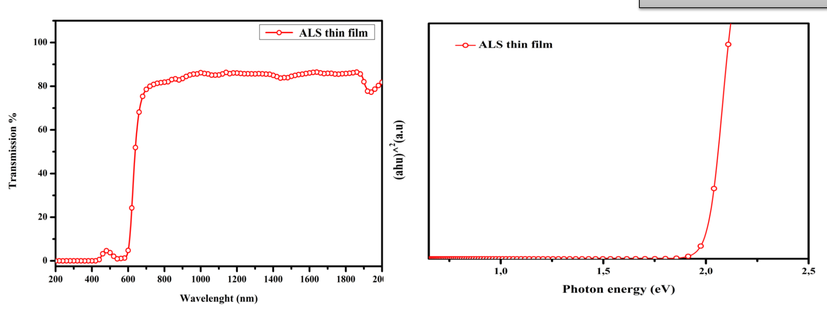


Figure 1: transmission spectra and band gap of ALS film deposited by spin-coating on a glass substrate

- **In the spectra, ALS exhibited a significantly sharp drop of the transmission in the visible range around 600 nm.**
- **The dye is able to absorb light in the visible range due to his band gap Eg= 1,8 eV**

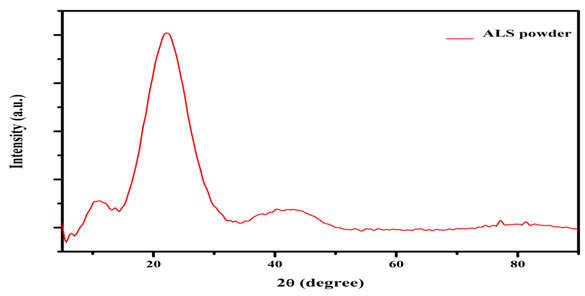


Figure 3: the X-ray diffraction spectrum of ALS powder

- **The diffraction pattern reflects a polycrystalline nature of the ALS powder.**

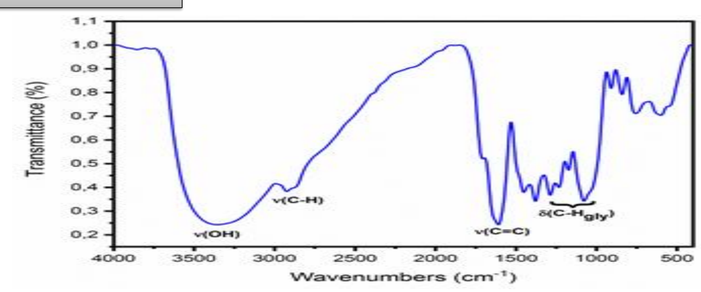
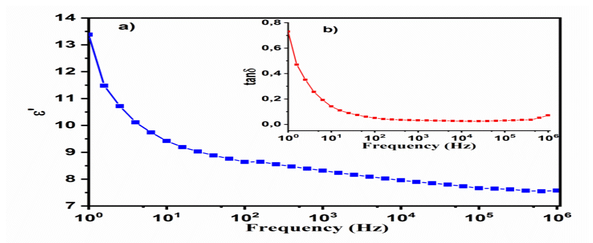


Figure 4: FTIR spectra of ALS powder

- **The functional groups in the ALS powder were analyzed through FT-IR. The spectra illustrated in Fig. 4 is a typical spectra of anthraquinones derivatives (main compounds in the Aloe Latex (ALS) extracted from the leaves of Aloe Vera plant)**



	ε'	Tanδ	|Z| (kΩ)	CPE-T	CPE-P	Rp (Ω)
1 kHz	8.5	0.03	60	4×10^{-12}	0.9745	4.18×10^{10}
1MHz	7.5	0.07	50000			

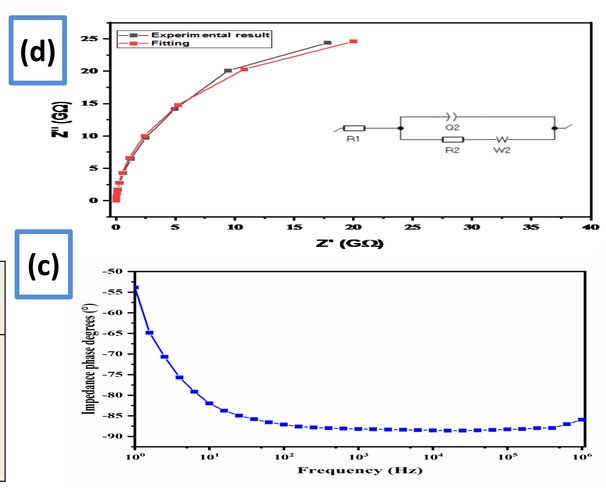


Figure 2: (a) dielectric constant, (b) dielectric loss (c) impedance phase degrees as a function of frequency and (d) Cole–Cole plots.

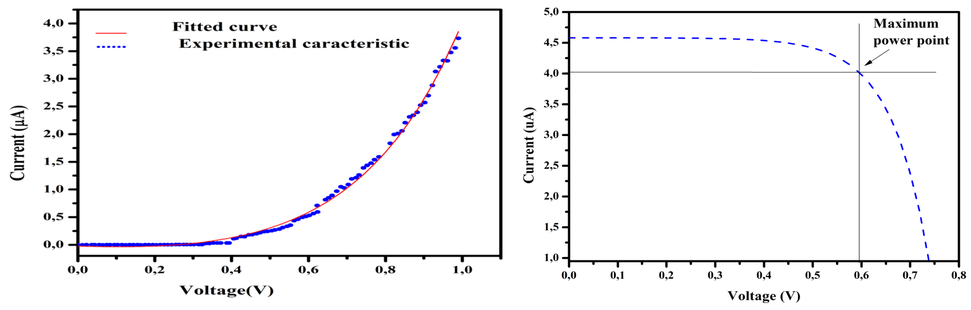


Figure 5: comparison of I-V characteristics of the solar cell in darkness and lighting

- **This Figure presents I-V characteristics in darkness and under illumination 60 mW / cm2 of two types of photovoltaic cells based on ZnO and Aloe Latex.**

CONCLUSION & PERSPECTIVES

- **In this context, our work consists, first of all, in seeking methods of valorization of natural dyes and their application on photovoltaic cell .**
- **Dye-sensitized solar cell (DSC) is a new class of green photovoltaic cell based on photosynthesis principle in nature.**
- **The solar cell performance can be improved by further optimization such as using other electron transporting layer, by doping the natural material with nanoparticles, or by building another solar cell architecture.**