Effect of Time of Deposition on Solid State Properties of Chemically Deposited copper tin Sulphide (Cu_2SnS_3) Thin Films.

Babatunde Rasaq & Elegbede Florence
Department of Science Laboratory Technology, The Federal Polytechnic, Ilaro, Nigeria
Corresponding email: rasaq.babatunde@federalpolyilaro.edu.ng

Introduction
The solar cells are made from semiconducting materials which have low bandgap energy. Semiconductors exist in elemental form such as silicon and germanium, compound forms such as binary examples are cadmium sulphide (CdS), zinc sulphide (ZnS); ternary compound copper tin sulphide (CTS) as an example and quaternary compound such as copper indium gallium disuphide, copper zinc tin sulphide. CTS is a p-type semiconductor in which its energy gap falls between 0.9 and 1.5 eV, and a high absorption coefficient of at least 106 m-1 these properties are similar to CZTS quaternary semiconductors**.**

Materials and methods
Soda-lime glass (SLG), copper nitrate ($Cu(NO_3)_2$), tin chloride ($SnCl_2$) and thiourea (CH_4N_2S), methanol (CH_3OH), triethylamine (TEA) served as the substrate, copper, tin and sulphur sources, solvent and complex agent, respectively. The substrates were cleaned ultrasonically. The precursor solution was made from 0.2 M ($Cu(NO_3)_2$), and 0.1 M ($SnCl_2$) at an equal volume of 50 ml. The solution was heated at 60°C and stirred for 1 hr after which 10 ml of TEA and 50 ml of 0.3M CH_4N_2S were added. The precursor was further stirred for another 2 hrs. The precursor solution was poured into a 50 ml chromatographic tank where three cleaned substrates were vertically placed. The substrates were allowed to stay in the solution at room temperature and removed after 15 min, 30 min and 45 min respectively. After the substrates had been coated with the films of CTS at their various time intervals, they were then annealed at 200oC for 1 hr. The films were characterised optically and structurally with UV-vis spectrophotometer and X-ray diffractometer, respectively.

Results and discussion
The optical absorbance measurement shows that the film deposited for 45 minutes had higher absorbance in comparison with the films coated for 15 and 30 minutes respectively. Also, the transmittance and reflectance of the films grew at 15 minutes and were higher than others. The reason that may be attributed to the higher absorptance, low reflectance and transmittance for the films deposited for 45 minutes could be due to the increase in film's thickness because the longer the time of deposition the higher the thickness of the films deposited. Also, the structure pattern of the films was polycrystalline with several peaks such as (002), (210), (310) and (024) diffracted at angles $2\Theta = 40, 48, 68$ and 84 degrees, But the most intense peak occurred at $2\Theta = 48$ degrees. But as the time of dipping increases, the intensity of the peaks also increases.

Conclusions
The films of CTS were coated on glass substrates via the chemical bath deposition method and the effect of times of deposition was studied. The study showed that the films coated at a longer time reflect and transmit low photons and had a polycrystalline structure.

Keywords: Photons, precursor, semiconductor, solar cell, time.