UAEU جامعة الإمارات العربية المتحدة United Arab Emirates University

**The College of Graduate Studies and the College of Engineering Cordially Invite You to a**

**Master Thesis Defense**

Entitled

**Study of Electrodeposition of Copper-Indium Alloys**

by

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**College of Engineering**

Date & Venue

**1:30 PM**

**Monday, 14 June 2021**

**Microsoft Teams**

https://teams.microsoft.com/l/meetup-join/19%3ameeting_YTE3ZDVlZmEtN2JjMi00ODI2LWIyNmUtNzc3YjdlYTU1MmEw%40thread.v2/0?context=%7b%22Tid%22%3a%2297a92b04-4c87-4341-9b08-d8051ef8dce2%22%2c%22Oid%22%3a%22e0ff224b-aa1f-47ab-a1d8-8d517a5e4a82%22%7d

# Abstract

Copper-Indium material for the fabrication of CIS/CIGS thin-film solar cells and for other applications is one of the most auspicious and highly researched upon material currently being studied in the solar energy and other industries. In the past, there have been several methods used for the fabrication of chalcopyrite thin-film solar cells. However, one of the best methods in the industry is electrodeposition, which employs the principles of electrochemistry to deposit materials on a working electrode. In this thesis, the cyclic voltammetry and constant deposition method to deposit the copper indium material were studied. In order to better understand the electrochemical behaviors during the co-deposition of copper and indium, a systematic cyclic voltammeteric study was undertaken on a carbon electrode. Several problems were faced during this study and were successfully resolved.

The main objective was to study the electrochemical process and endeavor to optimize the parameters such as pH and deposition potential in order to get better deposits in terms of their characteristics. This study would be an elementary study for further researches which would increase the efficiency of the CIS thin-film solar cells. The characterization was done by SEM, EDS and XRD studies. Moreover, the effect of addition of two different complexing agents, namely EDTA and trisodium citrate was studied. Complexing agents assist in the codeposition process. Thus, in this research, samples with and without the usage of complexing agents were studied.

Cyclic voltammograms produced reduction peaks around -0.2 V and -1 V versus SSC respectively for copper and indium using both trisodium citrate and EDTA complexing agents. The position of the peaks is similar using both the complexing agents proving the efficacy of EDTA as a suitable complexing agent. EDS studies provided compositional analysis for the films deposited by constant deposition method. pH studies indicate no prominent peaks at more acidic pH. This could be attributed to the poor stability of the electrolyte solution at higher pH. Thus, it could be concluded that additional compounds need to be added to increase the stability of the solution if the pH has to be increased. The reason to perform SEM, EDS and XRD characterization was to help identify the reaction mechanism, the structure and morphology of the films deposited under different conditions. Results of SEM studies showed that the presence of indium might suppress the formation of copper and vice versa. XRD analysis shows the presence of CuIn layer and that (200) is the preferential plane to the growth of the CuIn films.



**Keywords**: electrodeposition, CIS, thin-film solar cells, complexing agents, cyclic voltammetry.