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| **DEPARTMENT:** | Department of Physics |
| **AREA OF EXPERTISE:** | Thin Film Solar Cells |
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| **DATE OF DISPUTATION:** | June 30, 2017 |
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| **DISSERTATION TITLE:** | *Synthesis and Characterization of Cu2O/ZnO*  *Heterojunctions for Applications in Thin Film*  *Solar Cells* |
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| Summary  Fokuset på denne tiltalingen er å studere bred bandgap halvleder, kobberoksid (Cu2O) og grensesnittet til Cu2O/ZnO heterojunksjon for utvikling av solceller. Resultatet viser at målkraft har innflytelse på fasens og relavantegenskapene til Cu2O ved magnetron sputterin g. Videre viser filmene tynn epitaksial vekst når de blir avsatt på en c-akse ZnO enkelt krystall med et ekstra CuO ultra tynt lag. Det ultra tynne laget anses å være hovedårsaken til tap av kraftkonvergenseffektivitet i slike solceller.  Solar cells based on wide band gap semiconductors, i.e., Cu2O and ZnO, are attractive for investigations. Because they have high predicated power conversion efficiency (PCE) with theoretical value of 20% and they are also suitable for fabrication of tandem solar cells with Si based solar cells. Besides, semiconductor oxides are chemically stable, non-toxic and earth-abundant, enable manufacturing in large scale at low costs. However, bulk and interface defects are believed to hinder further improvement in PCE from the current experimental value of 8% in these *p*-*n* heterojunctions.  In this study, CuxO with different phases (such as CuO, Cu2O and Cu4O3) prepared by rf magnetron sputtering is first studied. Each of the phases has different semiconducting properties. In order to keep Cu2O being the prevailing phase in the film, target power has been particularly investigated for its influence on the film and associated properties. The results show that Cu2O dominates the film with a high transmittance spectrum at 190 W, in comparison with the film deposited at 140 W. Besides, grain size of the films increases with the power, correlating well with a high hole mobility of films deposited at high powers. At the same time, the film exhibits high growth rate and better crystallinity when they are deposited at high powers.  Further, Cu2O films display epitaxial growth when they are deposited on c-axis monocrystalline ZnO substrates. This holds for both reactive and ceramics sputtering, regardless of the termination of the substrates. A roughly 5 nm monoclinic CuO interfacial layer is observed as an intermediate layer to the substrate and it arises due to the 7.6% lattice mismatch to release the strain. However, this interfacial layer is considered to be detrimental to the performance to the heterojunction thin film solar cells. Because it has a bandgap of 1.5 eV, quite different from 2.2 eV in Cu2O, leading to energy barriers at the interface. Besides, the interfacial defects will act as recombination centers for the charge carriers. | |