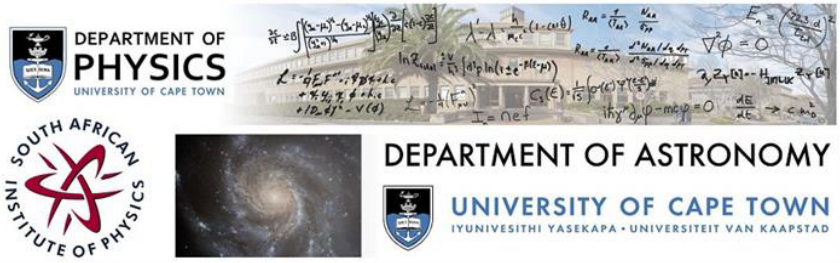

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CZTS solar cell: CZT precursor layer deposition by electron beam evaporation and electroplating

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Abstract content
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A sufficiently efficient Copper zinc tin sulfide (CZTS) solar cell will allow for solar cells to be built using low environmental impact materials and processes in a relatively simple way, at a more affordable cost. The photo absorber layer of a CZTS solar cell is the naturally p-type semiconductor Cu_{text5}2ZnSnS_{text5}4, sometimes referred to by the name of the naturally occurring mineral called kesterite. The substrate has been grown by evaporating a thin layer of Mo onto glass, the glass provides support for the subsequent layers, and the Mo acts as the bottom contact of the photovoltaic cell. The first step in producing the required CZTS crystal structure was the deposition of Cu, Sn and Zn in a 2:1:1 ratio. Software, apparatus and methods were developed to grow the CZTS crystal layer using electroplating. For initial characterisation, the Cu-Zn-Sn precursor layer was deposited using electron beam evaporation. To create an optimal bottom contact with Mo, Cu was deposited onto the Mo followed by Sn and then the Zn. Zn was deposited at the end to minimise the loss of Sn during annealing.. Sulfurisation of the precursor layer completed the Cu_{text5}2ZnSnS_{text5}4 structure. This was done by annealing the structure in a sulfur containing atmosphere. Characterisation of the thin layers (Cu-Sn-Zn) and the CZTS layer was done by Auger Electron Spectroscopy (AES), X-ray Diffraction (XRD) and Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS), before and after the annealing process.

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