

P24 Large-scale deposition of copper (I) thiocyanate hole transport material for use in perovskite solar cells

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Copper (I) thiocyanate (CuSCN) is an optically transparent, wide bandgap (3.4-3.9 eV), p-type semiconductor used in organic and perovskite solar cells. In comparison to other hole transporting materials (HTMs), CuSCN is economically favourable and comparable in performance, with efficiencies for hybrid organic-inorganic metal halide perovskite solar cells exceeding 20% [1].

Current research involves several solution-processable methods such as spin coating, spray coating and doctor blading. This study reports the first ever deposition of CuSCN via aerosol assisted chemical vapour deposition (AACVD). AACVD is a scalable ambient-pressure technique with low processing costs and simple reactor design. An added advantage is the flexibility over material choice due to the process being dependent on the solubility of the precursor, rather than the volatility as in conventional chemical vapour deposition techniques.

The study involves deposition of CuSCN using diethyl sulfide solvent. The deposition temperature, concentration of solution and amount of precursor solution deposited were varied to form a uniform film. CuSCN films produced were further optimised by studying the growth characteristics. CuSCN films deposited via AACVD were compared to films produced by conventional spin coating methods. Scanning electron microscopy (SEM), atomic force microscopy (AFM), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and ultraviolet-visible spectroscopy (UV-Vis) were used to determine morphological, structural and optical information.

Using the optimised conditions, AACVD CuSCN was incorporated into a working methylammonium lead iodide perovskite solar cell. Addition of interlayers, different electron transport layers and device architectures were explored to determine structure with highest performance. Studies into the solar cell performance allowed further understanding of the less well-known CuSCN HTM. Solar cells were tested under AM 1.5 and a champion efficiency of 10.44% was achieved, which represents the first ever working solar cell using AACVD CuSCN.

[1] N. Arora, M. I. Dar, A. Hinderhofer. Perovskite solar cells with CuSCN hole extraction layers yield stabilized efficiencies greater than 20%. *Science* (2017) 768-771.