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Synthesis and structural characterisation of cadmium dithiocarbamate ionic liquids

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Cadmium dithiocarbamate complexes, $[\text{Cd}(\text{S}_2\text{CNR}_2)_2]$, have found application as precursors for cadmium sulfide (CdS) thin film development and subsequent incorporation into photovoltaic devices. However, their dimeric nature limits their solubility in green, organic solvents commonly used in solution deposition routes to thin film formation.[1] To increase the solubility of $[\text{Cd}(\text{S}_2\text{CNR}_2)_2]$ complexes, a series of monomeric cadmium dithiocarbamate salts were synthesised and structurally characterised using synchrotron X-ray diffraction.

The cadmium dithiocarbamate anions, $[\text{Cd}(\text{S}_2\text{CNR}_2)_3]^-$, are charge balanced by ammonium counter ions which include tetramethylammonium (Me₄N), tetrapropylammonium (Pr₄N), 1-propyl-3-methylimidazolium (C₃mim) and 1-butyl-1-methylpyrrolidinium (C₄C₁py). The latter two counter ions are known to form ionic liquids, due to their asymmetry and poor crystal packing abilities, and when used allowed the formation of cadmium dithiocarbamate ionic liquids. The C₃mim $[\text{Cd}(\text{S}_2\text{CNR}_2)_3]$ compounds were room temperature ionic liquids, while the C₄C₁py $[\text{Cd}(\text{S}_2\text{CNR}_2)_3]$ compounds were crystalline materials at room temperature and melted at temperatures below 100°C. Investigation of the overall crystal packing arrangement of these structures allowed for better understanding of their thermal properties in the solid state, in particular the formation of ionic liquids using the C₃mim and C₄C₁py cations, in contrast to the tetraalkylammonium cations. All compounds showed a higher solubility in common laboratory solvents and therefore can be deemed as viable precursors towards CdS thin film formation using solution deposition processes.

1. Knapp, C. E.; Carmalt, C. J. Chem. Soc. Rev. 2016.

Keywords

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