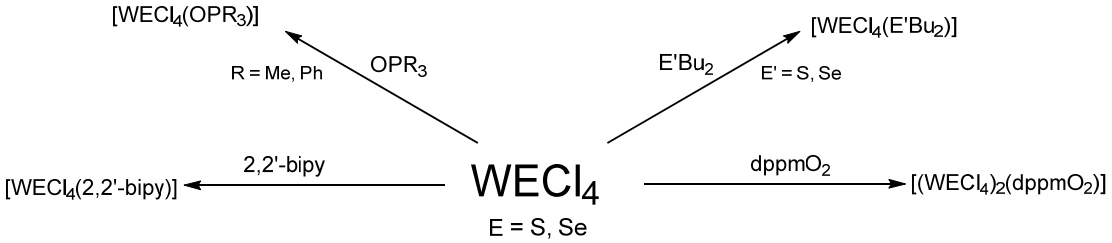
COORDINATION CHEMISTRY OF $WSCl_4$ AND $WSeCl_4$: TOWARDS PRECURSORS FOR WE_2 THIN FILM DEPOSITION

Victoria Greenacre[a], Danielle Runacres[a], Vikesh Sethi[b], Ruomeng Huang[b], C. H. (Kees) de Groot[b], William Levason[a], Gill Reid[a]

[a]School of Chemistry, University of Southampton, Southampton, UK
[b]School of Electronics and Computer Science, University of Southampton, Southampton, UK

The early transition metal dichalcogenide (TMDC) semiconductors adopt layered structures akin to graphene, whilst being notably more stable and possessing tunable band gaps. Binary materials such as WS_2 and WSe_2 are of considerable interest for a range of high-tech applications when the properties of the layered structure are exploited when in thin-film form.[1] A single source precursor containing both the W and S or Se in a single molecular species can allow better control over the film stoichiometry and growth. With this in mind, we have developed the coordination complexes of tungsten(VI), in particular $WOCl_4$, $WSCl_4$ and $WSeCl_4$, with various neutral ligands.[2-4]

Presented is the synthesis of complexes of $WSCl_4$ and $WSeCl_4$ with a range of neutral donor ligands, including some unusual examples with softer neutral donor ligands (pnictines and chalcogenoethers). Under certain conditions they can also promote reduction of the metal centre. Trends in the solution and solid-state spectroscopic data will be highlighted, together with the crystal structures of representative examples.



Selected complexes have also been evaluated as single source precursors for low pressure chemical vapour deposition (LPCVD) of WS_2, WSe_2,[4] and the ternary material WSSe.[5]

The development of precursors beginning from $WECl_4$ for the electrodeposition of thin films WS_2[6] and WSe_2 will also be discussed.

[1] M. Chhowalla, Z. Liu, H. Zhang,. *Chem. Soc. Rev*., 2015, **44**, 2584-2586.

[2] V. K. Greenacre, A. L. Hector, W. Levason, G. Reid, D. E. Smith, L. Sutcliffe, *Polyhedron*, 2019, **162**, 14-19.

[3] D. E. Smith, V. K. Greenacre, A. L. Hector, R. Huang, W. Levason, G. Reid, F. Robinson, S. Thomas,. *Dalton Trans.*, 2020, **49(8)** 2496-2504.

[4] V. K. Greenacre, A. L. Hector, R. Huang, W. Levason, V. Sethi and G. Reid. *Dalton Trans.*, 2022, **51**, 2400-2412.

[5] V. Sethi, D. Runacres, V. Greenacre, A. L. Hector, W. Levason, C. H. (Kees) de Groot, G. Reid and R. Huang, *J. Mater. Chem. A*, 2023, Accepted Manuscript

[6] S. Thomas, V. K. Greenacre, D. E. Smith, Y. J. Noori, N. Abdelazim, A. L. Hector, C. H. (Kees) de Groot, W. Levason, P. N. Bartlett, G. Reid, *Chem. Commun*., 2021, **57**, 10194-10197.