Preparation of Chalcogenide Materials for Next Generation Optoelectronic Devices

D.W. Hewak,[1*] C.C. Huang[1], J. Yao[1], K. Khan[1], P. Bastock[1], F. Al-Saab[1], B. Gholipour[3], J.S. Maddock[1], E. Weatherby[1], C. Craig[1], K.F. MacDonald[1], N.I.Zheludev[1,3], Y.G. Fedorenko[2], M.A. Hughes[2,] R.M. Gwilliam[2], K. Homewood[2], and R.J. Curry[2]

[1]*Optoelectronic Research Centre, University of Southampton, Southampton, SO17 1BJ, UK*
[2]*Advanced Technology Institute, University of Surrey, Guildford, GU2 7XH, United Kingdom*
[3]*Centre for Disruptive Photonic Technologies, Nanyang Technological University, Singapore 637371*
[*]Corresponding author: dh@orc.soton.ac.uk

Chalcogenide materials are finding increasing interest as an active material in next generation optical and electronic devices. There wide range of properties, ranging from photosensitivity, ability to host rare earth ions, electrical conductivity, phase change, exceptional optical non-linearity's to name only a few are fueling this interest. Moreover, the ability to synthesize these materials in numerous forms as diverse as 2D monolayers, microspheres, optical fibres, nanowires, thin films as well as bulk glass ingots of over a kilogram in size ensures their application space is vast.

We began preparation of chalcogenides, largely based on sulphides, in 1992 and since then have built up an extensive capability for their purification, synthesis and fabrication in various forms. A key aspect of this facility is the ability to process in a flowing atmosphere of hydrogen sulphide which provided the capability of synthesis from elemental, oxide or halide precursors, processing through various chemical vapour deposition reactions as well as post purification.

In this talk we describe recent additions to the range of materials we synthesize highlighting transition metal di-chalcogenides for electronic applications, an example of which is shown below, crystalline semiconductors for solar cell applications, ion implanted thin films which provide carrier type reversal, low power phase change memory devices, switchable metamaterial devices as well as traditional chalcogenides glass and optical fibre.

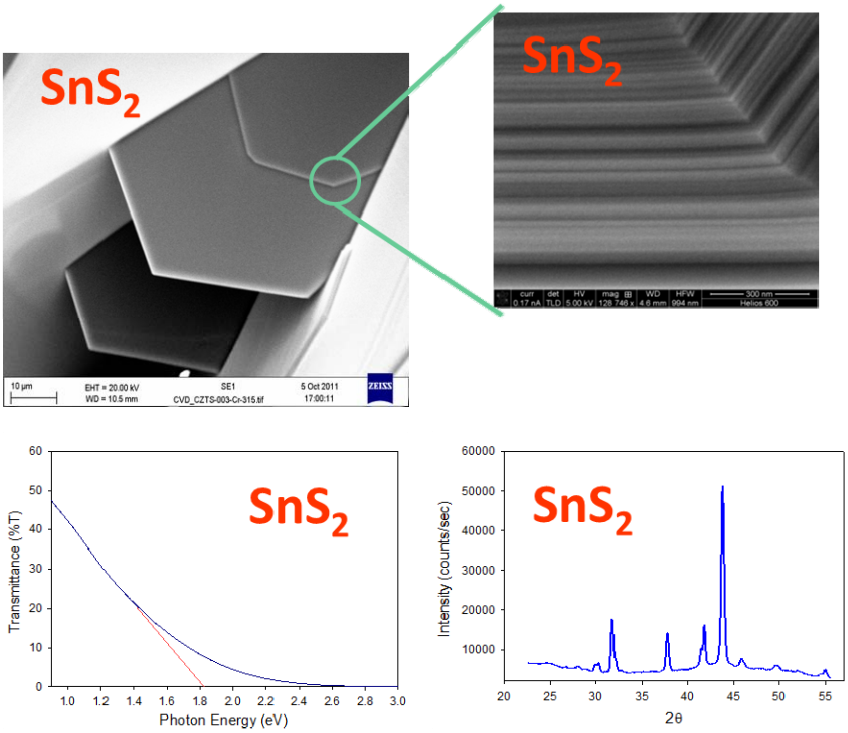

Fig. 1. a) SEM images of chemical vapour deposition (CVD) grown Sn-S thin films (b) UV-VIS-NIR and (c) XRD pattern of CVD grown Sn-S thin films.