# Adsorption of organic molecules on transparent semiconducting substrates.

**D.A. Evans[a], Di Hu[a], S. Astley[a], G.T. Williams[b], M.W. Allen[c]**

[a]Department of Physics, Aberystwyth University, Aberystwyth, UK
[b]Element Six Ltd., Harwell, UK
[c]Department of Electrical and Computing Engineering, University of Canterbury, NZ

The adsorption of organic molecules on semiconducting substrates is relevant to many applications from energy generation to drug delivery. Surface analysis using combined methods provides the most complete picture of surface structure, chemistry and electronic states, especially when a combination of methods is applied in-situ and in real time.

Transparent oxides such as indium tin oxide (ITO) are almost exclusively used as substrates in photovoltaic (PV) devices for solar energy, usually as thin films on glass substrates. However, there is a growing interest in alternative and specialist substrates, for example UV absorbing materials for organic PV (e.g. ZnO) and ionizing radiation resistant substrates (e.g. diamond).

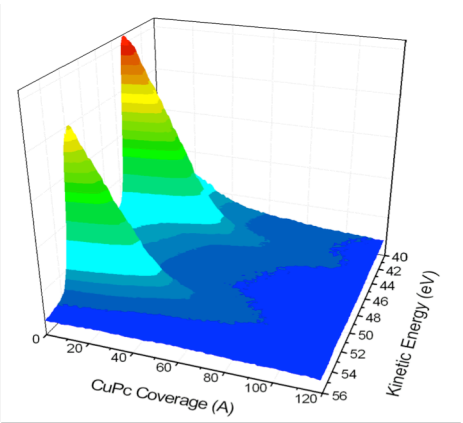


Fig. 1. Real-time monitoring of the growth of a CuPc film on a transparent oxide substrate.

We have applied in-situ surface analysis to the growth of small organic molecules on several substrates to optimize the substrate, the thin film growth and the interface energetics[1]. Rapid screening and improved accuracy is achieved by data collection in real time as shown in Fig. 1 for CuPc growth on an ITO substrate. The attenuation of the substrate core level peaks provides the thin film growth mode (layer-by-layer in this case) while the energy position quantifies changes in band-bending and surface conductivity. Lineshape analysis reveals chemical changes and the optical gap of the organic semiconductor[2]. The complete interface energetics are provided by the excitation of core and bonding electrons using a range of sources from optical to UV to x-ray. For ZnO, this approach has enabled the high work function and 2-d conduction of the (0001) surface to be preserved at the inorganic-organic interface.

*Keywords:* Interfaces; Organic semiconductors; photovoltaics

**References**

[1] R. Heinhold, G. T. Williams, S. P. Cooil, D. A. Evans, M. W. Allen, *Physical Review B* **2013**, *88*, 235315.

[2] D. A. Evans, A. R. Vearey-Roberts, O. R. Roberts, G. T. Williams, S. P. Cooil, D. P. Langstaff, G. Cabailh, I. T. McGovern, J. P. Goss, *J. Appl. Phys.* **2013**, *114*, 123701.