Project Title: 'Deposition Techniques for Thin Film Ternary Semiconductor Solar Cells'
Principle Investigator: Prof A Hill (University of Salford)
Project duration: 30/09/09 – 01/10/08
Grant Value: £50,492

In the UK, the government has set up ambitious targets for the production of electricity from renewable sources, 10% of electricity by 2010 and 15% by 2020, and solar power is expected to make a significant contribution to this. Therefore the development of low-cost, efficient and environmentally friendly photovoltaic technologies will be of enormous benefit to society as a whole. It will also provide significant business opportunities internationally as countries strive to move towards more sustainable ways of generating electricity. The development and manufacture of solar cell modules for the production of electrical power is a growth industry with considerable wealth-creating potential for North West UK manufacturers during the next century

Although semiconductor solar cells have been extensively explored as a clean means to convert solar energy into electricity (photovoltaic or photoelectric), the dominant photovoltaic technologies of today suffer from a great drawback of high cost and lengthy pay-back period. Most solar cells are made out of silicon which is an expensive material and its cost has been driven up further by a recent shortage. This is restricting the take-up of these cells and therefore the amount of electricity which can be generated this way. So it is highly desirable to develop thin-film solar cells which are much more economical. These techniques involve applying a thin coating of one material to the surface of another usually by coaxing the coating material from a vaporous or dissolved state using electricity, high heat, chemical reactions, evaporation, or other techniques. By doing this solar cells can be created using only a small amount of the expensive photovoltaic material making them significantly cheaper to produce than traditional silicon cells. CuInSe2 (CIS) based thin film solar cells are the most promising replacement candidates because this material has a relatively high solar efficiency, is resistant to solar radiation damage and has a low toxicity.

Of the companies developing CIS (Copper, Indium, diselenide) solar cells, three categorical approaches have emerged so far: using evaporation, nano particles, and thin film targets. How these manufacturers develop their processes in their respective categories will be the greatest area of technical differentiation and in large determine CIS cell efficiency and cost. To date, CIS solar cell production has only made it from the lab to the production floor with evaporation. Each process strategy has limitations in part governed by the material form factor. For example, material for evaporation (the material is heated up until it vaporizes) is easy to obtain and use, however, the process itself can be inefficient in material usage, slow to coat substrates and difficult to control.

This project extended previous work carried out at the University of Salford on pulsed DC magnetron sputtering (PDMS), a technique used to deposit thin films of a material onto a surface, for use on CIS solar cells. The purpose of which is to establish whether PDMS offers a realistic approach for the industrial production of CIS solar cells. The project also involves experiments to replace some of the materials used in CIS cells with more efficient or less toxic alternatives.