Project Title: 'Third generation Solar Cells based on Quantum slicing by Rare earth doped Silicon nanocrystals'

Principle Investigator: Dr M P Halsall

Project duration: 1/1/2008 – 1/09/2009

Grant Value: £74,752.00

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.

Current commercially available silicon solar cells are typically 10-20% efficient at converting sunlight into electricity. The main limitation in these materials is that they absorb nearly all the light that falls on them creating electrons, but they waste 80-90% as heat when the electrons lose excess energy on absorption. If one could convert the short wavelength (Blue) sunlight that falls on them to an equivalent amount of energy in the infrared, the electrons would lose almost no energy on absorption and the efficiency of the devices could almost double. Such a "quantum-slicing" technology has been the goal of solar cell research for many years. Recently it was reported that rare earth elements such as erbium or neodymium when incorporated into silicon oxide containing tiny clumps of silicon (nanocrystals) could be made to emit two infrared "photons" of light for each incident blue photon. This is very attractive as an industrial technology as silicon oxide can be formed on silicon solar cells by merely heating them in oxygen. However, the rare earth element used in these experiments was erbium whose emission is not suitable for harvesting with silicon. This project investigated the incorporation of a different element – neodymium in such materials. They will deposit optimised neodymium doped silicon oxide layers containing nanocrystals onto prototype silicon solar cells to demonstrate improved efficiency. Doping is the process of introducing impurities into an extremely pure semiconductor, in this case silicon rich oxide (SRO), to change its electrical properties.

The project builds on an EPSRC grant (value £192k) which funded the work that developed the original technology and is effectively a three way collaboration between the University of Manchester, the University of Surrey and McMaster University. The work carried out on this project led on to a £1.5m multicentre grant award (ESPRC) to follow up the underlying IP. An additional £200k was also awarded by ESPRC to investigate biosensing applications of the technology.