Project update

Pioneering bid for solar power and light

Project details

Project title	E.nanowires – Enabling nanowires to create and to harvest light
Participant	Lund University, Sweden
Start date	2008

Key aims

- Exploitation of nanowire structures for solar energy conversion and lighting
- Develop a common technology platform for solar cells and LEDs
- Lower the capital cost of solar photovoltaics to compete better with non-renewable sources.

Project summary

An emerging technology is being developed into highly efficient sources of electricity and light under a nanoscience project sponsored by E.ON's International Research Initiative.

A new generation of solar cells and light emitting diodes – LEDs – will be created using advanced manufacturing of semiconductor nanowires on a silicon platform.

The results are designed to improve the efficiency and cost of photovoltaic cells in harvesting the sun's light as electricity and to enable more economic manufacture of LEDs which can operate at near 50 percent efficiency.

The two devices are seen as having significant potential to reduce the use of fossil fuels for electricity generation and to lower the current 20 – 25 percent of electricity that is used for lighting.

Lund University's Faculty of Engineering proposed this project which is led by Professor Lars Samuelson, professor of solid state physics and director of the university's Nanometer Structure Consortium (nmC), and Knut Deppert, head of the Epitaxy and Nanocrystals group at the nmC.

The university will study the fundamental physical and technological processes involved in generating and harvesting light to transfer the semiconductor nanowire concept to functional devices.

Two techniques will be combined to manufacture the common electronic platform for generating electricity from solar cells and light from LEDs.

The university will apply the expertise it has pioneered in designing and forming complex nanowires for use in a high performance semiconductor, known as a type III-V. These are widely used in high speed electronic devices and circuits.

The nanowires will be integrated with a silicon wafer, which is a lower-cost base material than other options and allows the use of well-developed silicon technology fabrication tools.

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Good progress has so far been made on three aspects of the design and manufacture of the complex nanowires which are to be used in the nanowire photovoltaic structures (NWPVs).

In the first area, researchers have successfully explored ways of adding desired impurity atoms – known as 'doping' – to the nanowires whilst they are being grown.

By focusing on the results of introducing so-called 'dopant precursors' to the nanostructure materials, the researchers have been able to study a number of interesting effects. These include the nanowire growth rate, crystal structure and the electrical and optical characteristics.

This is a crucial aspect of developing nanowires with the required performance and properties.

The second area of achievement was in solving the major problem of tapered growth in nanowires.

Industrial production of nanowires tends to lead to structures with tips and bases which are of different sizes. This results from atoms attaching themselves in a way that causes growth on the sidewalls of the nanowires.

By introducing minute amounts of gaseous hydrogen chloride into the growth process, the researchers suppressed the sidewall growth, creating untapered nanowires.

Resolving this issue was vitally important to the project. This is because its aim is to create multiple sections of nanowires with different doping characteristics and levels. But sidewall growth in adjoining layers could 'shortcut' the whole structure.

The third area of activity has seen the start of design work for the set up needed to determine the internal quantum efficiency of the nanowires.

This work is investigating the nanowires' electrical sensitivity to light and their ability to harvest the sun's light as electricity. A range of calculations have been carried out with 'very promising' results.

Other work that has taken place involved characterizing the optical properties of various nanowire structures.

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