Home-grown electricity

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Buildings may soon be able to generate their own electricity from roofs, walls, windows – even benchtops – that come with in-built solar power capabilities.

How would you like to turn most of the surfaces in your home into mini power stations while maintaining their beauty and serviceability? A collaboration between Australian research institutions and industry is moving towards this goal by commercialising solar cell technology that can harness solar energy from walls, windows and steel roof sheeting, improving the energy efficiency of buildings.

The collaboration, known as the Victorian Organic Solar Cell Consortium, was boosted by a A$3.4 million grant from the Victorian and Commonwealth governments late last year. Its members include Monash University, the University of Melbourne, CSIRO, and industry partners BlueScope Steel, Securency International, Bosch and Innovia Films. The stakes are potentially high.

The project aims to develop a commercial process to produce what are known as dye-sensitised solar cells and organic solar cells that are printed on flexible materials. It combines original and applied research, but the emphasis is on commercialising technology.

Professor Yi-Bing Cheng, a materials engineering specialist from Monash, holds a thin piece of plastic printed with parallel whitish strips of colour between his fingers and says the "objective is to prove the concept is industrially viable". In the two-pronged project, Professor Cheng is a leader of the Monash team, which focuses on dye-sensitised cells, while counterparts at the University of Melbourne are working on organic solar cells.

Both technologies are aimed at developing more flexibly deployable alternatives to traditional silicon solar photovoltaic cells. The dye-sensitised version, based on nanotechnology, works like this: a thin layer of titanium oxide (about 20 microns) is laid on a base, and highly light-absorbing dye molecules are adsorbed onto this titanium oxide surface.

Because titanium oxide particles are extremely small and porous, they create a very large surface for the dye molecules to attach to, effectively making tiny nano-sized stacks. So pronounced is this effect that the titanium oxide film has 300 times the surface area of its actual footprint.

The dye molecules have the capacity to create electricity. When a photon from sunlight strikes a dye molecule it creates an electron, which is carried by the semiconducting titanium oxide and out through an external circuit to power lights or other electrical devices. The circuit then delivers the spent electrons back to the solar cell, where they react with an electrolyte and regenerate the dye molecules, preparing them to generate another electron.

Dye-sensitised cells have been around for about 20 years, but the Monash project has some significant points of difference from the 'traditional' technology. At Monash, ferrocene – an iron-based organometallic compound – and cobalt compounds are replacing iodide to create the electrolyte that returns spent electrons to the cell. These new electrolytes increase the generation efficiency of the solar cells and have the potential to greatly expand the life span of the solar cells.

Provided by Monash University

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