Diamond dust in space-based energy conversion

Project details	
Project title	Lithiated nanoparticle diamond energy converter
Participant	University of Bristol, UK

A novel technique that creates electricity using the sun and generation technology from space exploration is being investigated in E.ON's International Research Initiative.

Scientists plan to exploit solar heat to produce electricity in devices called thermionic energy converters (TECs) for which they are developing special electrodes using nanoparticles of diamond powder.

TEC principles have been widely used in space travel since its start, but these latest electrodes are designed to lower operating temperatures substantially while maintaining a potential energy conversion efficiency of more than 40 percent.

Results should enable a TEC to operate satisfactorily on solar power, leading to a renewable powered generation device that has no moving parts or fluids, is free of maintenance and able to deliver reliable electricity production over a long service life.

This project was conceived at the University of Bristol. The Principal Investigator is Dr. Neil Fox, a Great Western Research Fellow in wide band gap nanomaterials and a staff member in both the School of Chemistry and the Department of Physics. Dr Fox is working with: Professor Mike Ashfold, Head of the Physical and Theoretical Chemistry Section; Professor David Cherns, Head of the Micro- and Nanostructural Materials Group; and Professor Mervyn Miles, Head of the Nanophysics and Soft Matter Group.

The research will focus on developing new electrodes comprising semiconducting nanocrystals of diamond made from low cost, readily-available industrial diamond powder. Trace elements of lithium are added to improve the electrode's key operating boundaries.

Solar energy is used to heat the negative electrode – cathode – to the point where it releases electrons producing a flow of electricity across the vacuum in the TEC. The electricity generated can then be transferred to external circuits.

The project aims to achieve operation below 'red heat' level, possibly as low as 320˚ Celsius. Conventional TECs with metal electrodes require temperatures well above 1,500˚ Celsius to produce sufficient electrical current.

Further parts of the project will look at other factors including those affecting the density of the current.

Final stages will be field tests of a prototype TEC with a target efficiency above 25 percent compared to a maximum of about 15 percent in current devices.

The trials, in south-west England and southern France, will use parabolic dishes to concentrate the sun's rays to provide heat energy for the cathode. The UK locations are the highest latitudes at which a domestic-sized TEC using solar power could meet most of a property's annual generation needs.

This project aims for a solar-based technology that may be an alternative to photovoltaics, requiring less space and having potential along the sunnier coastlines of the UK and Europe.

The wider market would be to link the new TECs with plant that is already available to concentrate solar power for utility, commercial and domestic use via other technologies.

In the longer term, TECs raise the prospect of developing a cost-effective renewable resource, whose supply is virtually unlimited, if the electricity is transported from the world's solar belts to areas of high demand.

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