



Project update

# Diamond dust in space-based energy conversion

Project details		Key aims
<b>Project title</b>	Lithiated nanoparticle diamond energy converter	
<b>Participant</b>	University of Bristol, UK	
<b>Start date</b>	2008	<ul style="list-style-type: none"> <li>• Development of a high efficiency, long-life device for converting solar power to electricity</li> <li>• Utilization of an almost limitless renewable resource in the world's solar regions</li> <li>• Provide an alternative solar energy technology to photovoltaics.</li> </ul>
Project summary		
<p>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</p>	<p>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</p>	<p>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.</p>

## Progress report – 1

**Two designs have been produced for prototype thermionic converters (TEC) as part of the initial activities of this project.**

The first prototype converter has been installed in a demountable vacuum system. It enables different arrangements of components to be tested and operates on a lower thermal capacity. One of its roles will be to test different nano-particle diamond materials processed with lithium (Li-D) .

The second prototype is a portable TEC and has a dual purpose:

- To allow a proof-of-concept demonstration at an early stage of the project
- To provide a test bed for the new electrodes made from Li-D.

This vacuum device will be a resealable unit, enabling it to be tested and disassembled afterwards for quick

reconfiguration. Its size and power were chosen to amplify sensitivities arising from the specification of the Li-D material or changes in the operating methods.

At this stage of the project the converter will take its thermal power from a radiant heater element. Later it will be tested using the sun's rays through concentrated solar power provided by a parabolic dish.

Preparatory work has also taken place to produce Li-D material. Coating equipment has been modified and fitted with further monitoring devices. In addition, existing batches of Li-D material have been investigated using advanced analytical techniques to assess how the addition of lithium affects the diamond powder.

Tests were also carried out to compare the thermionic performance of

Li-D coatings and those applied to thermionic cathodes used in industry.

Two major purchases of equipment were completed. A desktop laser micromachining tool was obtained to machine the electrode surfaces. The second purchase was a new ultra high vacuum scanning probe microscope which, in addition to other equipment, will analyze at an atomic scale the physical and chemical properties of the most promising Li-D materials.

A source for a second solar concentrator platform has also been identified. Two datasets of sunlight infrared observations at ground level have been obtained, which will be analyzed for thermal power availability and thermionic converter capacity.

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