Three Excellent European Research Projects share €1m Descartes Prize for Research

Three research projects financed by the European Commission were today awarded a share of the €1m Descartes prize for Research at a ceremony in Brussels. The High Energy Stereoscopic System is a telescope system that has revolutionised existing astronomical observation techniques and increased our knowledge and understanding of the Milky Way and beyond. The Hydrosol project has developed a method of producing hydrogen from water-splitting, using the energy of the sun, which could lead to environmentally friendly production of hydrogen for energy purposes. The third project, APOPTOSIS, has made great strides in our understanding of apoptosis (programmed cell death), which will lead to new developments in future treatment of cancer and AIDS. The awards were given at a ceremony in Brussels, attended by the German Federal Minister for Education and Research, Dr Annette Schavan and European Science and Research Commissioner, Dr Janez Potočnik. The ceremony coincides with celebrations of the contribution of research to the European Union over the last 50 years.

The High Energy Stereoscopic System (HESS) brings together about 100 scientists from Germany, France, the UK, Ireland, Poland, the Czech Republic, Armenia, South Africa and Namibia. With EU support they have designed and built the system, developed the complex software needed to collect and analyse data and offered training to young astronomers and astrophysicists.

The Hydrosol project is composed of academics and businesses from Greece, Germany, Denmark and the UK, and was awarded an International Global 100 Eco-tech award in 2005 and a Technical Achievement award from the International Partnership for the Hydrogen Economy in 2006.

APOPTOSIS brings together some of the leading names in cell biology, from Austria, Denmark, France, Germany, Italy and Sweden to examine the mechanisms involved in programmed cell death. Since 2001, the team's research papers have been cited over fifty thousand times in other publications, an extraordinary indicator of the team's success.

A further five projects were also recognised as finalists. These are: NEMABS (Gaining a clear picture of molecules through colouring); QGATES (Quantum mechanics for breakthroughs in information processing); TAMRAM (Thermally Assisted Magnetic Random Access Memory); DYNAQPRIM (Protein dynamics in cell nuclei) and GLOBALIFE (Life courses in the globalisation process)

Launched in 2000, the EU Descartes Prize for Research rewards teams of scientists for outstanding scientific or technological results achieved through trans-national research in any field of science, including the social sciences, humanities and economics.
This year's winners were selected from amongst 13 nominees, which were in turn selected from 66 submissions. The award is selected by the Grand Jury, chaired by Ms Claudie Haigneré, former French Minister for EU Affairs and ESA Astronaut. The Jury is made up of

22 eminent scientists from 11 EU countries, plus Brazil, Morocco, Russia and Turkey, and covers a broad range of scientific disciplines.

Descartes Prize for Science Research

Winner: Project HYDROSOL
Solar Hydrogen Production via Water Splitting

Coordinator: Dr Athanasios Konstandopoulos
Participating Countries: Greece, Germany, Denmark, UK

The HYDROSOL team has developed an innovative solar thermo-chemical reactor for the production of hydrogen from water splitting, resembling the familiar catalytic converter of automobiles. The reactor contains no moving parts and is constructed from special ceramic multi-channelled monoliths that absorb solar radiation. The monolith channels are coated with active water-splitting nanomaterials capable of splitting water vapour passing through the reactor by trapping its oxygen and leaving as product pure hydrogen in the effluent gas stream. In a next step, the oxygen trapping material is solar-aided regenerated (i.e. releases the oxygen absorbed) and a cyclic operation is established on a single, closed reactor/receiver system. The integration of solar energy concentration systems with systems capable to split water will have an immense impact on energy economics worldwide, as it is a promising route to provide affordable, renewable solar hydrogen with virtually zero CO2 emissions.

The uniqueness of the HYDROSOL approach is based on coating nanomaterials with very high water-splitting activity and regenerability (produced by novel routes such as aerosol & combustion synthesis) on special ceramic reactors with high capacity for solar heat absorption. The production of solar hydrogen will offer opportunities to many poor regions of the world which have a huge solar potential. Producing solar hydrogen will create new opportunities for countries of Southern Europe that can become local producers of energy.

HYDROSOL - Heralding a new age in energy

With traditional energy sources diminishing, interest in alternative energy supplies is increasing. Hydrogen is considered by many to be the next link in the evolution of energy, after nuclear energy. A new chemical engineering process hopes to make the 'hydrogen economy' a reality.

The 19th Century saw the beginning of the Industrial Revolution. Yet despite significant advances in technology, little has really changed in the way the world produces its energy. Most of the energy produced is created through the burning of fossil fuels like coal and oil, which has the negative side-effect of releasing CO2 into the atmosphere, one of the main causes of global warming.

The global supply of fossil fuels will not last forever and so the EU has committed its member states to increasing their renewable energy use as well as reducing their CO2 emissions. Energy experts have long pointed to hydrogen as a bright energy hope for the future. Hydrogen is cleaner than fossil fuels and is the most plentiful element in the universe.

However, hydrogen does not occur by itself in nature and is only found in combination with other elements, such as in the air we breathe or the water we drink.

The HYDROSOL project has come up with an innovative way of extracting hydrogen from water. Traditionally, the technology to split water (H2O) into its separate hydrogen and oxygen elements has been carried out through a process known as electrolysis. The problem with this method is that the energy required to extract the hydrogen comes from burning fossil fuels, resulting in an almost nil saving in fossil fuels.

HYDROSOL has overcome this problem through the use of a novel solar hydrogen production reactor, which produces practically zero carbon dioxide emissions and uses only solar energy and water. It is estimated that the cost of hydrogen produced in this way could be competitive within a decade, with non-renewable hydrogen currently produced from natural gas, attracting additional costs, for example, through emissions taxes. For Dr Athanasios G. Konstandopoulos - the project's coordinator - clean, renewable and cost-effective energy is only half the story. For him, an equally significant achievement is the revival in the field of Chemical Engineering that Solar Hydrogen Chemical Technology promises to bring about.

Solar hydrogen production is made possible by a key development in the project: nanomaterials with high water-splitting ability, undergoing cycles of oxidation and reduction. These nanomaterials are used as coatings in the HYDROSOL solar monolithic reactor, the reactor itself allows this process to be simply repeated continuously without modifications.

Monolithic reactors first emerged from traditional Chemical Engineering, with their most familiar application being the automobile catalytic converters. For the first time, this reactor geometry has been successfully transferred to solar applications, creating a state-of-the-art solar hydrogen reactor. The reactor contains no moving parts and is made from a high temperature ceramic material, which is heated by absorbing concentrated solar radiation. The reactor geometry is that of a honeycomb with many millimetre-sized parallel channels, each of them coated with the active water-splitting nanomaterial.

As water vapour travels through the reactor, oxygen atoms are absorbed by the coating in the honeycomb channels, similar to the way a sponge soaks up water, leaving only the hydrogen to carry on. The hydrogen produced is clean and ready for use. The 'oxygen-soaked' nanomaterial is then heated to release the oxygen allowing a cyclical operation, so that the entire process (water splitting and redox material regeneration) can be achieved in a single reactor. The process is easily adaptable for use with materials other than water where hydrogen can be found, such as natural gas.

This achievement was only made possible through the cooperation of four teams from complementary engineering fields of study and application. Co-ordinated by the Greek Aerosol and Particle Technologies Laboratory, the consortium consisted of; the German Aerospace Centre, Stobbe Technical Ceramics from Denmark and Johnson Matthey Fuel Cells from the UK.

The work has attracted interest from a number of international organisations including the UN who foresee a huge potential for technological transfer to developing countries with high

‘Solar Potential’"; thereby offering the prospect for the creation of new markets, as well as new energy sources.

The HYDROSOL project has attracted international recognition. In 2005, it was awarded an International Global 100 Eco-Tech award during the International Expo in Aichi, Japan, being selected among "… environment technologies that contribute significantly to the resolution of global environmental problems and to the creation of a sustainable future."

More recently HYDROSOL was awarded the International Partnership for the Hydrogen Economy (IPHE) inaugural 2006 Technical Achievement Award for being "…the world's first closed, solar-thermochemical cycle in operation that is capable of continuous hydrogen production." Results from this landmark research project promise the potential for long-term production of renewable based hydrogen, particularly for regions of the world that lack indigenous resources, but are endowed with ample solar energy.

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