

ENERGY FOR SUSTAINABILITY PROGRAM



**Environmental & Sustainability
Cluster**

Trung Van Nguyen

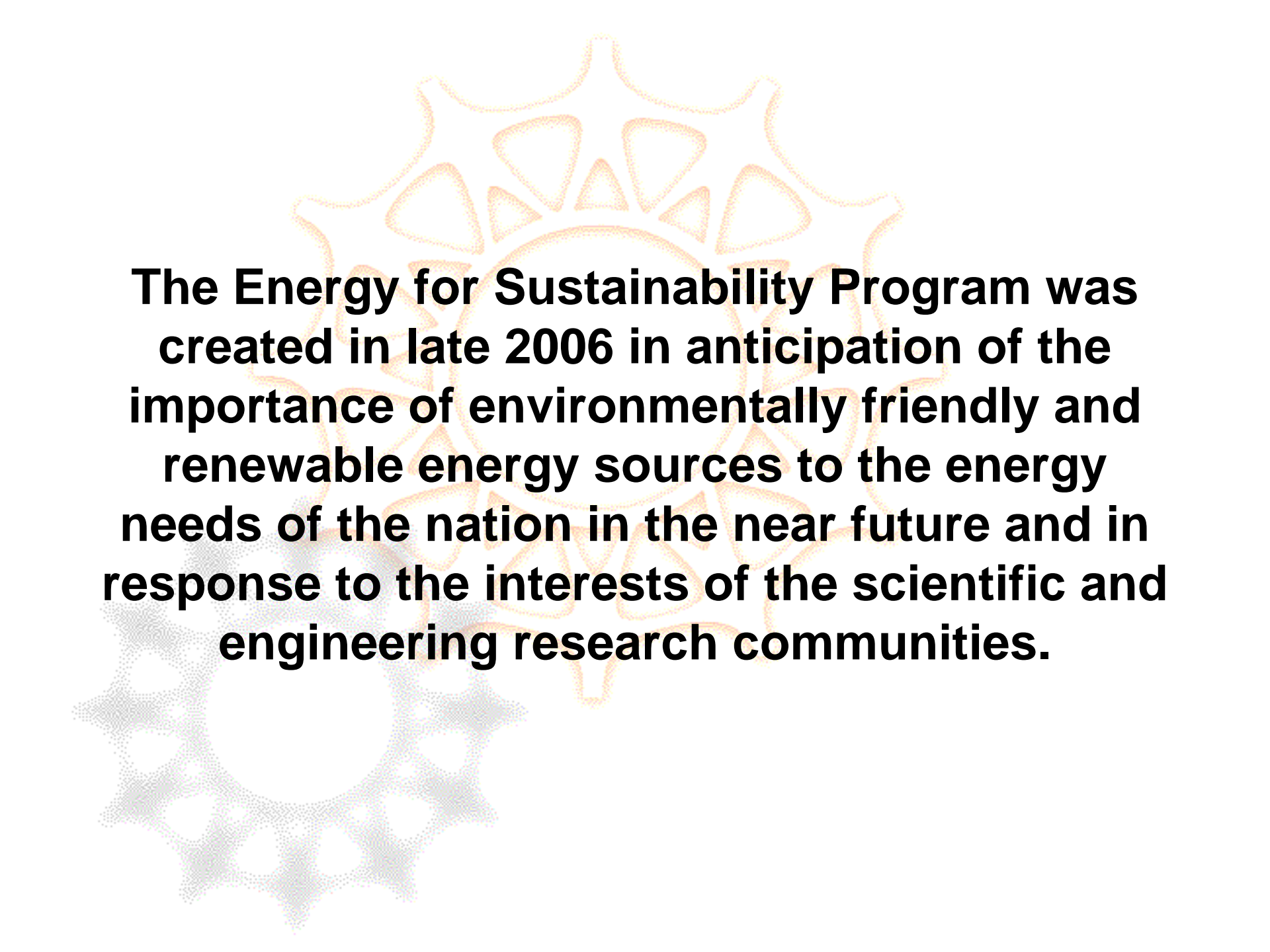
Director of Energy for Sustainability Program

CBET Division/Engineering Directorate

NSF

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The background features a large, faint, orange-toned sun with a gear-like center and rays extending outwards. In the bottom-left corner, there is a smaller, grey-toned gear. The text is centered over the sun graphic.

The Energy for Sustainability Program was created in late 2006 in anticipation of the importance of environmentally friendly and renewable energy sources to the energy needs of the nation in the near future and in response to the interests of the scientific and engineering research communities.



Supports fundamental and transformative research and education in the Generation, Conversion and Storage of Environmentally Friendly and Renewable Energy sources.

Program Investment Areas

Solar (70)

- New photovoltaic materials (**dye-sensitized, quantum dots/rods**) and fundamental understanding of energy conversion processes in these materials;
- Hydrogen generation by thermochemical and photoelectrochemical processes.

Wind (10)

- Fundamental understanding of complex fluid flow around blades and optimization of blade materials and design.

Biomass (30)

- Hydrogen and hydrocarbon generation from biomass
- Bio Fuel Cells

Program Investment Areas

(Continued)

H₂ Storage (10)

–Metal oxide and carbon nanostructured materials and fundamental understanding of hydrogen adsorption & desorption processes in these materials.

Fuel Cells (30)

-Low Temp. Systems: New ionic membrane materials for high temperature operation and increased durability; Novel water and thermal management concepts; Fundamental understanding of reaction and transport at catalyst/membrane interface;

-High Temp. Systems: New electrolyte materials; Improved 3-D distribution of electronic/ionic/gas reaction and transport interfaces.

Program Recent Awards

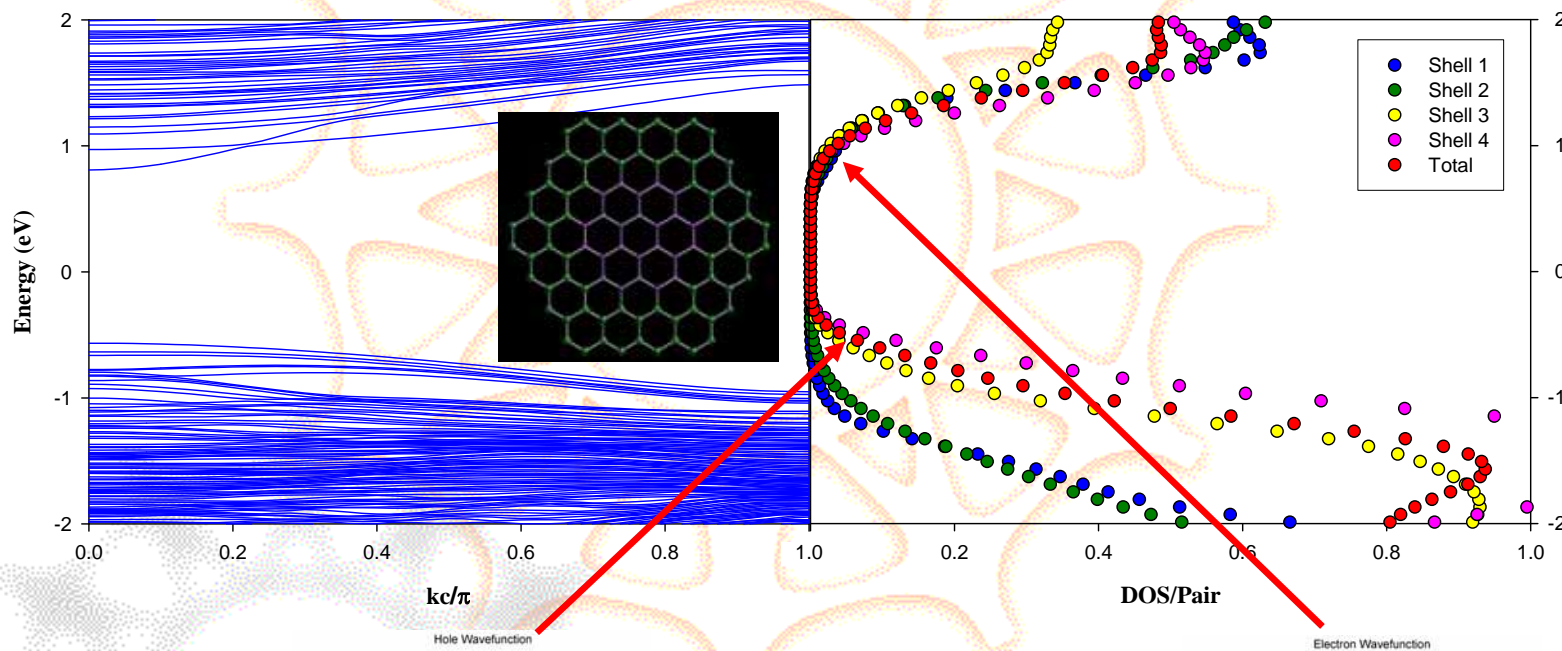
- *Molecular Engineering for Conversion of Biomass to Fuels, Chemicals and Materials – A. Datye/U. New Mexico*
- *Metal Coated B-N C60 Nanostructures for Hydrogen Storage – P. Jena/Virginia Commonwealth U.*
- *First-Principles Engineering of Nanoscale Kinetics in Advanced Hydrides – V. Ozolins/UCLA*
- *Binary and Ternary Quantum Rods for Photovoltaic Materials – R. Ramprasad/U. Connecticut*
- *Advances in Wind Turbine Analysis and Design – M. Smith/Georgia Tech*
- *Wind Turbine-Atmospheric Boundary Layer Interactions – L. Castillo/Rensselaer*

Program Recent Awards

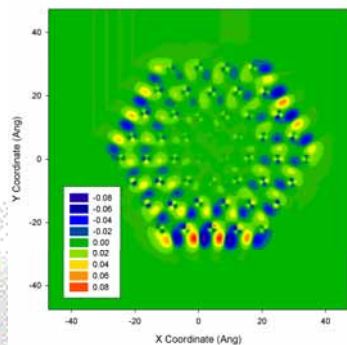
(Continued)

- ***Microbial Fuel Cells For Large-Scale Water Treatment – L. Angenent/Washington U.***
- ***Transport Phenomena in a Miniaturized Air-Breathing DMFC - A. Faghri/U. Connecticut***
- ***Electrolyte/Cathode Interfacial Structure in a PEM Fuel Cell – M. Janik/Penn State***
- ***Low Temperature Conducting Ceramics for SOFC – J. Nino/U. Florida***
- ***Nanoparticle Catalyst for Electrochemical Energy Conversion – P. Strasser/U. Houston***
- ***Bio-Inspired Fluid Dynamic Energy Conversion – J. Dabiri/Caltech***

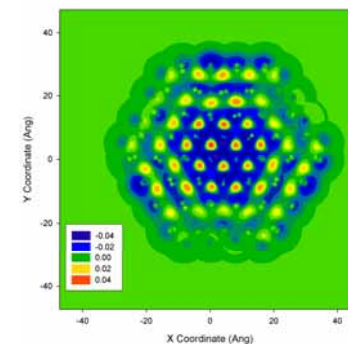
Core/Shell CdSe/CdTe Heterostructure Nano-Rod for Photovoltaic Cells - R. Ramprasad, University of Connecticut



Hole wavefunction localized in the CdTe shell

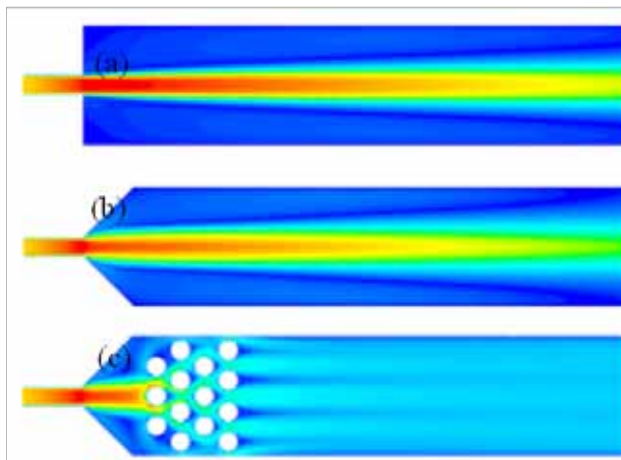


Electron wavefunction localized in the CdSe core

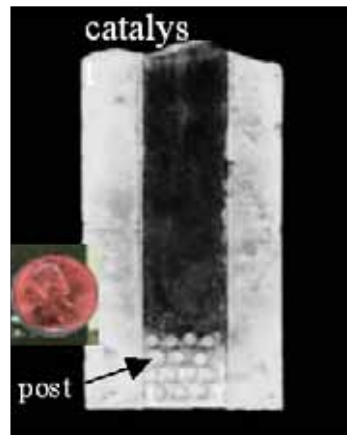


Microchemical Technology

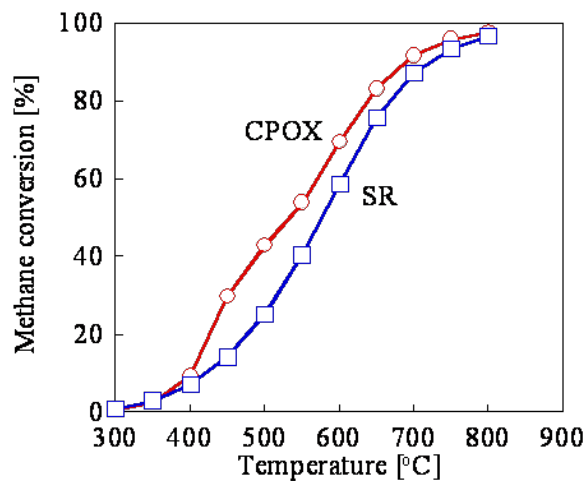
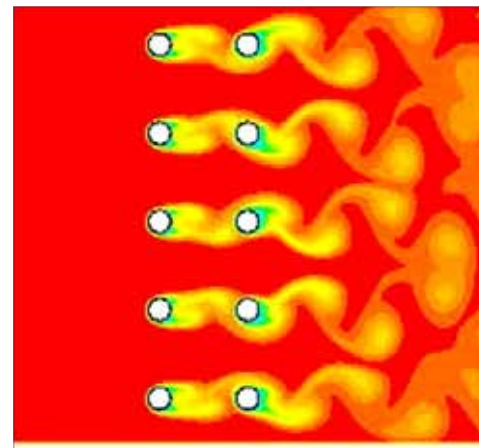
Contours of Velocity Magnitude



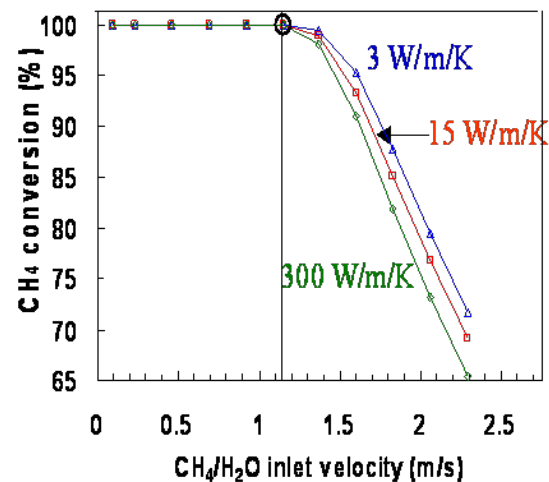
Micromixer/reactor



Hydrodynamic-driven mixing



Comparison of catalytic partial oxidation (CPOX) and steam reforming (SR) of methane under identical conditions.

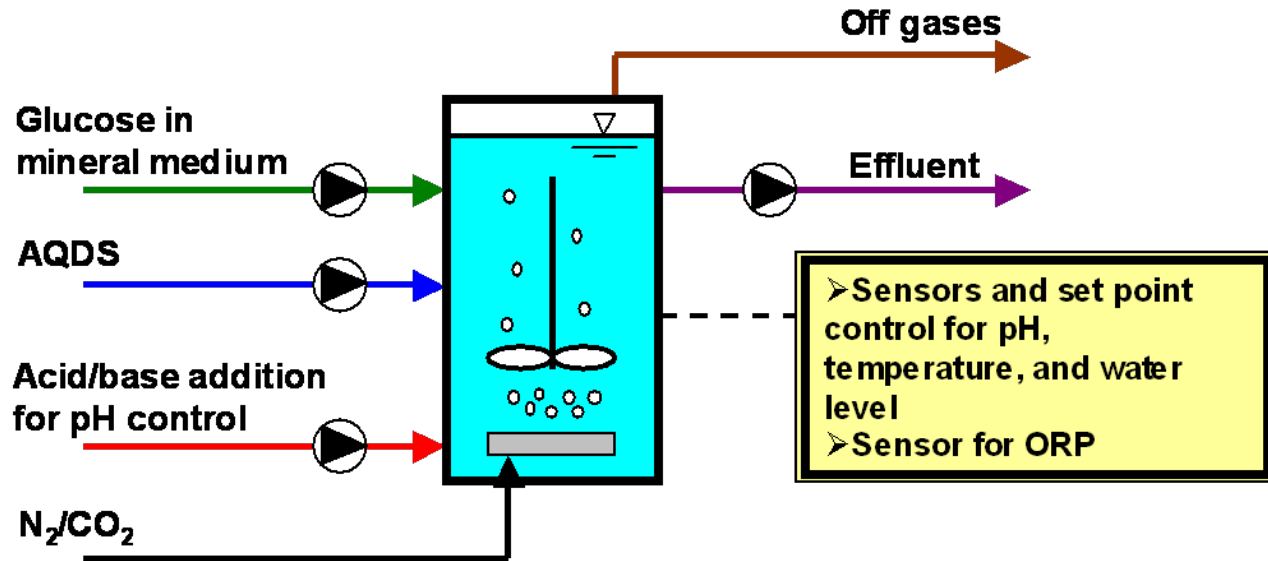


Effect of wall material of integrated steam reformer-microburner-heat exchanger on methane conversion at millisecond contact time.

H2 Production by Biological Processes

K. Finnegan – U. Illinois

Reactor Schematic

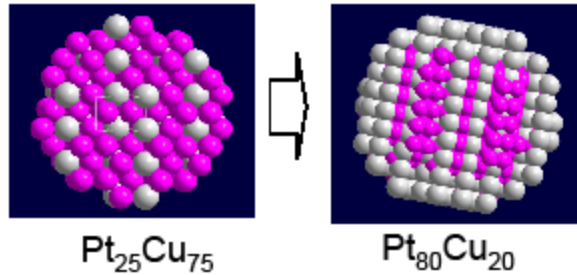


Photograph of Cell Suspensions

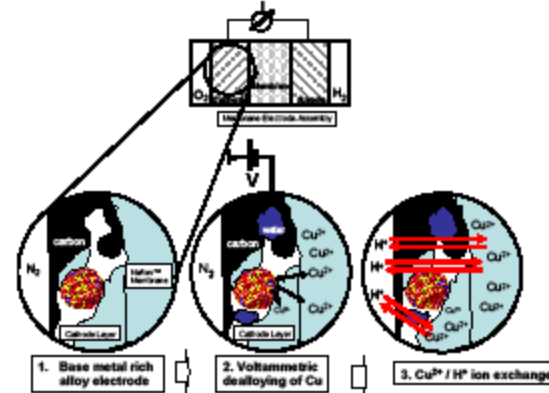


Nano-Particle Catalyst for Fuel Cells

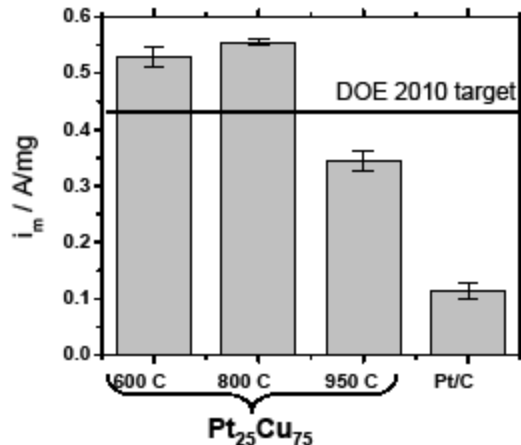
Nanostructured alloy Core-Shell Fuel Cell Electrocatalysts



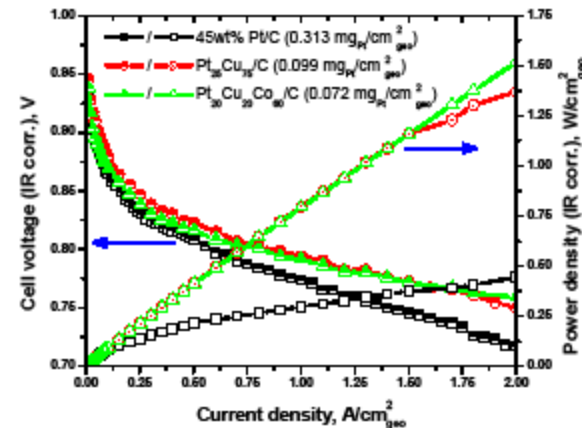
Synthesis of a nanostructured Pt-Cu alloy core-shell particle fuel cell cathode electrocatalysts by *Voltammetric Surface Dealloying*



In-situ Dealloying inside a FUEL CELL

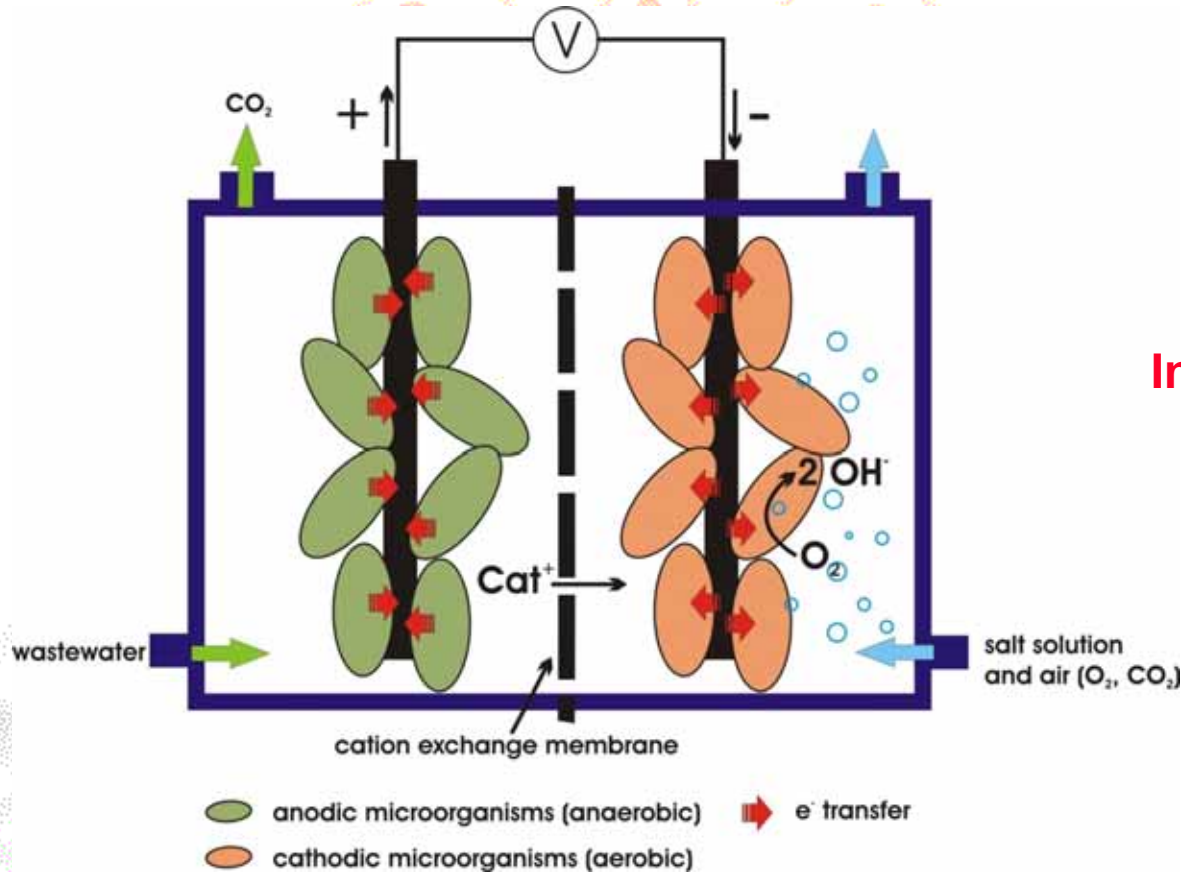


More than 4 times activity improvement
Compared to pure Pt catalysts in Half Cell Tests



4 times improved Single Fuel Cell Performance

Microbial Fuel Cells



Incorporating both microbial anode and cathode.

ES Core Activities

- CAREER
- Unsolicited Research
- SGERs
- Nano-Science & Engineering (NER/NI RT)
- Workshops
- International Activities
- 2007 Budgeted - \$3M/Actual - \$4M
- 2008 Budgeted - \$6M/Actual - \$7M?

ES 2007 Fund Distribution



	#	\$	%
Unsolicited	9	2,600,000	64.5%
Shared	1	250,000	6%
CAREER	2	800,000	20%
SGER	1	37,500	1%
NER	1	62,281	2%
PIRE	1	250,000	6%
Conferences/Workshops	2	11,000	0.3%
Supplements	1	6,250	0.2%
Total		\$4,017,031	100%

Co-Funding Programs

CBET Division

- Catalyst and Biocatalysis – *J. Regalbuto*
- Process and Reaction Engineering – *M. Burka*
- Thermal Transport Processes – *P. Phelan*
- Fluid Dynamics – *W. Schultz*
- Environmental Sustainability – *B. Hamilton*
- Interfacial Processes & Thermo. – *R. Wellek*
- Chemical & Biological Separations - *R. Wesson*

CMMI Division

ECCS Division

MPS Directorate (DMR/CHE/PHY)

ES Website

www.nsf.gov/eng/cbet/activities/

**Then click on 'CBET Home' Link
and select the ES Program.**