

International Institute for Carbon-Neutral Energy Research: Outline and Future Perspectives

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KYUSHU UNIVERSITY



ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Inamori Center, Ito Campus, Kyushu University
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I²CNER (Kyushu-Illinois WPI) Goals

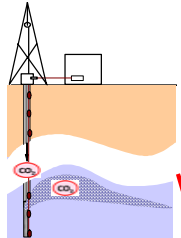
- **Advance fundamental science on Carbon-Neutral Energy Research to remove the barriers for a hydrogen fueled society and CO₂ capture and sequestration (CCS)**
 - Multi/Interdisciplinary approach to the study of interactions between hydrogen/CO₂ and materials
 - Solid/Fluid mechanics, Chemistry, Physics, Materials, Geoscience
 - Elucidate underlying fundamental mechanisms (e.g., adsorption, absorption, dissolution, diffusion, reaction)

- **Enable innovative technologies and enhance public awareness and acceptance**
 - Hydrogen production, hydrogen storage materials, hydrogen embrittlement resistant materials, next generation fuel cells, material transformation catalysts; CO₂ separation and concentration; CO₂ geo- and ocean-sequestration
 - Society decisions based on sound scientific information

- **Substantive contribution to the reduction of CO₂ emissions toward a carbon-neutral energy fueled society.**

Ito Campus: World Class Academic Environment

CO₂ Natural Analogue Test Field



Research Laboratory for High Voltage Electron Microscopy



Institute for Materials Chemistry and Engineering



INAMORI Frontier Research Center



Advanced Project Center

Seakeeping and Manoeuvring Basin/ High Speed Circulating Water Channel



Dormitory-1



Dormitory-2

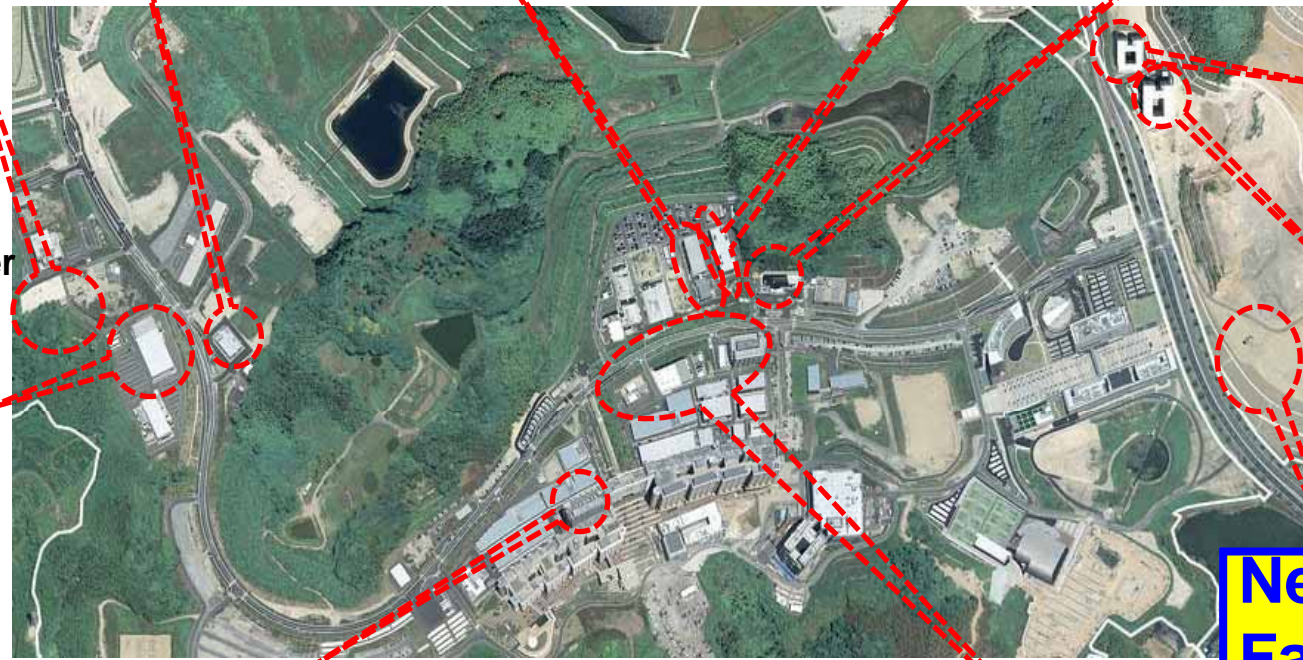


Center of Advanced Instrumental Analysis



Hydrogen related Facilities

New Facility will be built for WPI



Ito Campus: World Class Facilities

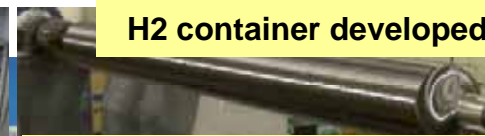
"Hydrogen Campus" (Research space >5000m², ca. 100 researchers, ca. 100 students)



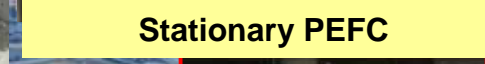
Intl. Res. Center for Hydrogen Energy



Materials fatigue testing units for hydrogen-related materials



H2 container developed



Stationary PEFC



(for Restaurant)



High-pressure H2 Lab.



High-pressure H2 Lab.



Fuel cell laboratory



Stationary PEFC



AIST-Research Center for Hydrogen Industrial Use and Storage (HYDROGENIUS)



Hydrogen station



Wind power generator



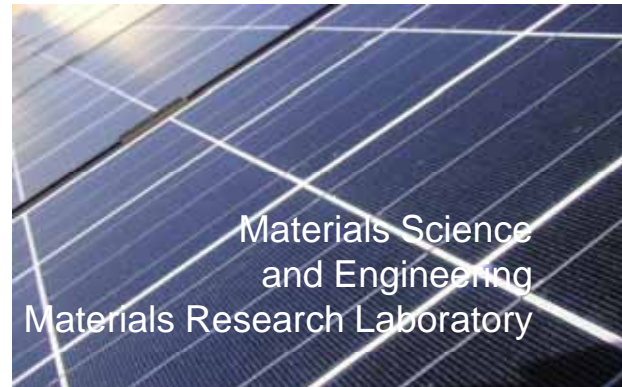
Illinois: A Tradition of Leadership and Impact

Top-Ten Engineering Graduate Programs

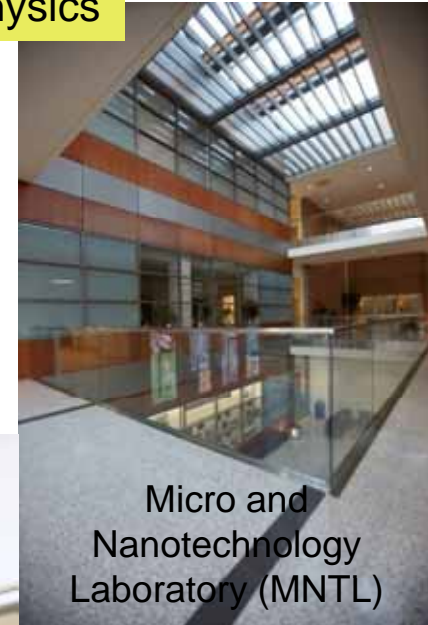
1. MIT
2. Stanford
3. UC Berkeley
4. Georgia Tech
5. Illinois
6. Carnegie Mellon
7. Caltech
8. Michigan
9. UT Austin
10. Cornell



Tony Leggett: 2003 Nobel Prize in Physics



Materials Science and Engineering Materials Research Laboratory



Micro and Nanotechnology Laboratory (MNTL)



Boeing Trusted Software Center



Center for Nano Science and Technology



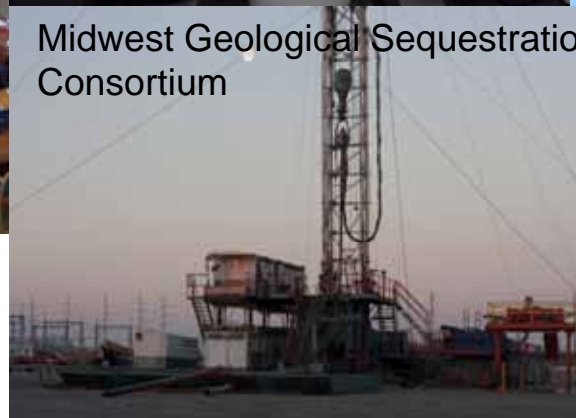
Computer Science

NCSA Petascale



Grainger Engineering Library

Largest engineering library in the nation



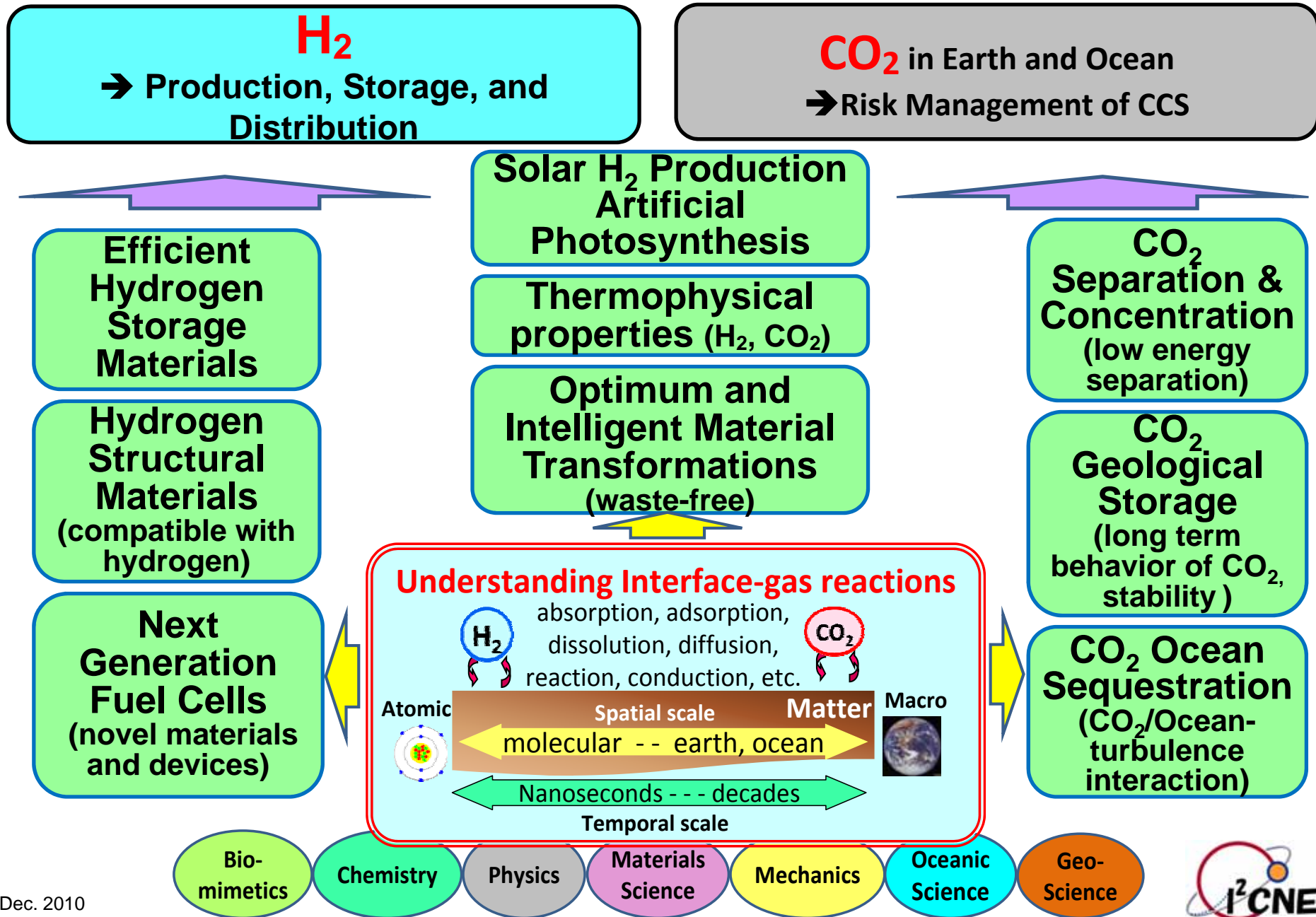
Midwest Geological Sequestration Consortium



Energy Biosciences Institute



I²CNER Technical Activities



I²CNER Programmatic Structure

■ Educational

- **Exchange of Graduate students, post-docs, and faculty**
 - Adjunct appointments at Kyushu and Illinois
- **High visibility conferences and workshops on key challenging topics**
 - Output: identify key roadblocks – these will guide the research agenda
 - Annually, alternating between Kyushu and Illinois
- **Scientist/faculty liaison in federal agencies in Japan and the US**

■ Institutional

- **Kyushu**
 - Foster an international environment by establishing an international network to promote fundamental research
 - New criteria and expectations for faculty hiring, development, promotion, and compensation
 - Independent management of Institute and decision making by foreigner director
- **Illinois**
 - Advance research collaborations with Japan
- **Kyushu/Illinois will develop the academic culture for the 21st century science and technology**
 - Provide the next generation of scientists
 - Address the energy challenge for Japan, the USA, the international community

There is no Time More Opportune for such an Effort (US President visited Tokyo on Nov. 13, 2009)

Announcement of initial areas relevant to the Proposed Institute of Kyushu University for joint activities to strengthen US/Japan cooperation

- Acceleration of joint activities between national laboratories of the United States and Japan through R&D cooperation, exchanges of information, knowledge and researchers, workshops and conferences, and collaboration on standards research
- Cooperation on carbon capture and storage including modeling, testing and data sharing for the purpose of prediction and mitigation of the possible risks, and the development of new capture methods, simulation tools and monitoring methods
- Enhancement of cooperative research, development and deployment activities in additional areas including basic research, renewable, energy efficient buildings, and next generation vehicles
- Close cooperation on energy issues and the development of joint projects in multilateral frameworks including the Major Economies Forum on Energy and Climate (MEF), International Energy Agency (IEA), the Asia-Pacific Partnership on Clean Development and Climate (APP), the International Partnership for Energy Efficiency Cooperation (IPEEC), the International Renewable Energy Agency (IRENA) and especially, the Asia Pacific Economic Cooperation (APEC) which Japan chairs in 2010 and the United States in 2011.

<http://www.whitehouse.gov/the-press-office/fact-sheet-us-japan-cooperation-clean-energy-technologies>

Why we Believe we can be Successful

■ Partnerships in place

- Midwest Geological Sequestration Consortium (Director Rob Finley)
- UC Berkeley (Ongoing research collaboration with MSE Department)

■ Livermore Valley Open Campus (LVOC) (In progress, NNSA funding)

- Sandia National Laboratories, Livermore (WPI office on site)
- Lawrence Livermore National Laboratory
- UC Davis

■ Industrial partnerships (emerging technologies for hydrogen compression)

- Concepts NREC
- Mohawk Innovative Technology Inc.
- ExxonMobil Corporation

■ Partnerships to be pursued

- Argonne National Laboratory (Energy Storage)

Leverage and Impact

- **Fukuoka Strategy Conference on Hydrogen Energy (JAPAN)**
 - **Mr. Aso, Governor of Fukuoka Prefecture**
 - **Strong presence of Toyota Motor Corporation**

- **HYDROGENIUS (JAPAN)**
 - **New Energy and Industrial Technology Development (NEDO)**

- **DOE/EERE (USA)**
 - **Fuel Cell Technologies Program (FCTP)**
 - Align interests in education, hydrogen storage, hydrogen production and delivery

- **NSF (USA)**
 - **Key Opportunities**
 - NSF International Programs (Target Japan)
 - NSF with DOE (EERE/BES) (New activities are underway to strengthen ties, in particular in the hydrogen area)
 - International Materials Institute awards
 - UCSB, Lehigh, Northwestern, Texas A M
 - Kyushu, Illinois, Berkeley, Sandia, Gottingen (Germany), Thessaly (Greece)
 - East Asia and Pacific Summer Institute for Graduate Students

“Fukuoka Team” for hydrogen energy



Dec. 2010



Expected Accomplishments over the Next 10 years

- Hydrogen-embrittlement resistant materials for the design of a safe and reliable hydrogen infrastructure
- Efficient and scalable hydrogen production through artificial photosynthesis
- Novel hydrogen storage materials (over 6wt% H₂ system capacity)
- Next generation efficient fuel cells through novel materials and devices
- New material transformation processes (catalytic oxidation) with no CO₂ and waste energy by-products
- Low cost/energy CO₂ separation and concentration processes
- Educate the public about the societal benefits of transitioning to a carbon-neutral hydrogen-fueled economy

I²CNER: Looking into the Future

- Contribute toward creating a sustainable and environmentally friendly society by advancing fundamental science to reduce CO₂ emissions and establish a non-fossil based energy carrier system
- Establish an international network to promote fundamental research for carbon-neutral energy and education
- Reform the educational and research culture of Kyushu University to meet the technological challenges of the 21st century

