Core Technology Consortium for Advanced Energy Devices
（最先端電池基盤技術コンソーシアム）

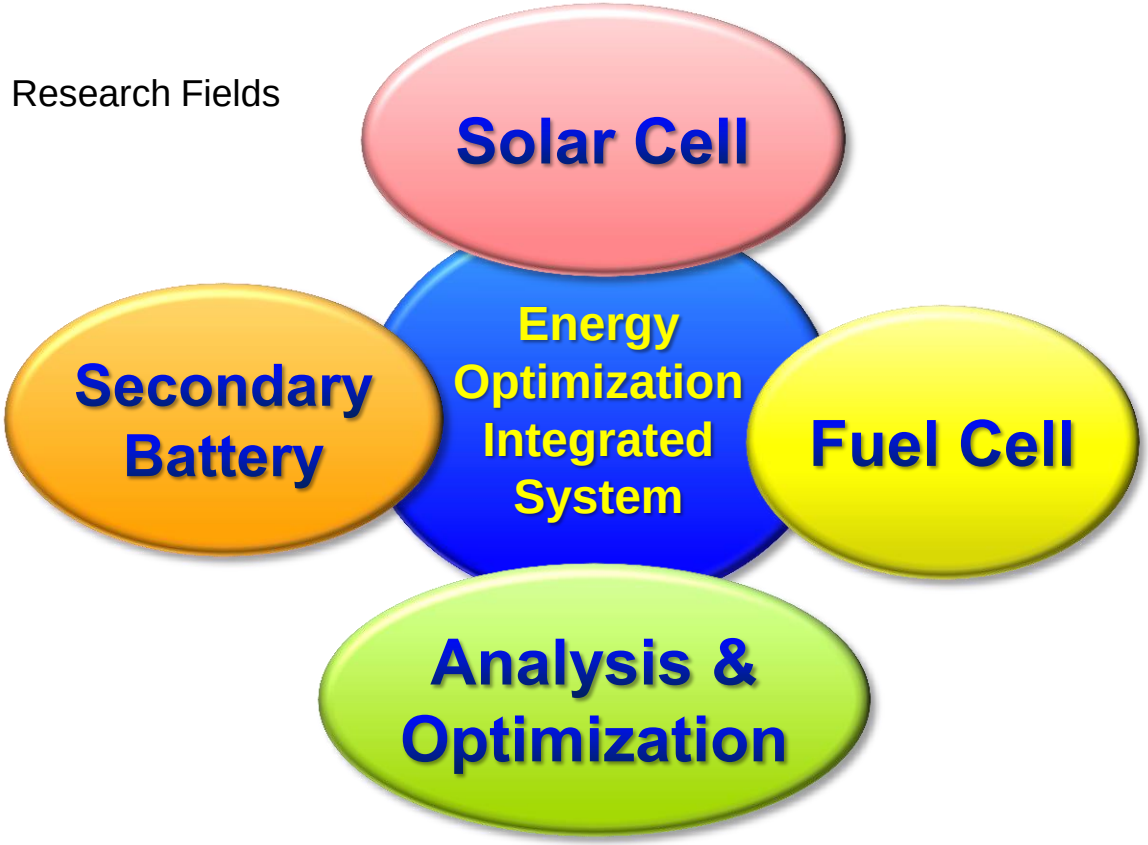
Tomohiro Kubota and Seiji Samukawa

Our web site:
http://www.ifs.tohoku.ac.jp/consortium/eng/
http://www.ifs.tohoku.ac.jp/consortium/jpn/

Core Technology Consortium for Advanced Energy Devices

2013～

Research Fields



Director
- Prof. S. Samukawa (IFS & WPI)

Solar Cell
- Prof. S. Samukawa (IFS & WPI)
- Prof. N. Usami (Nagoya Univ.)
- Prof. I. Honma (IMRAM)

Secondary Battery
- Prof. I. Honma (IMRAM)
- Prof. S. Orimo (WPI & IMR)
- Lecturer A. Unemoto (WPI)

Fuel Cell
- Lecturer M. Matsuo (IMR)
- Prof. S. Orimo (WPI & IMR)
- Researcher T. Ikeshoji (IMR)
- Prof. K. Amezawa (IMRAM)

Analysis & Optimization
- Assoc. Prof. T. Tokumasu (IFS)
- Assist. Prof. K. Shimoyama (IFS)
- Prof. K. Amezawa (IMRAM)
- Prof. A. Miyamoto (NICHe)

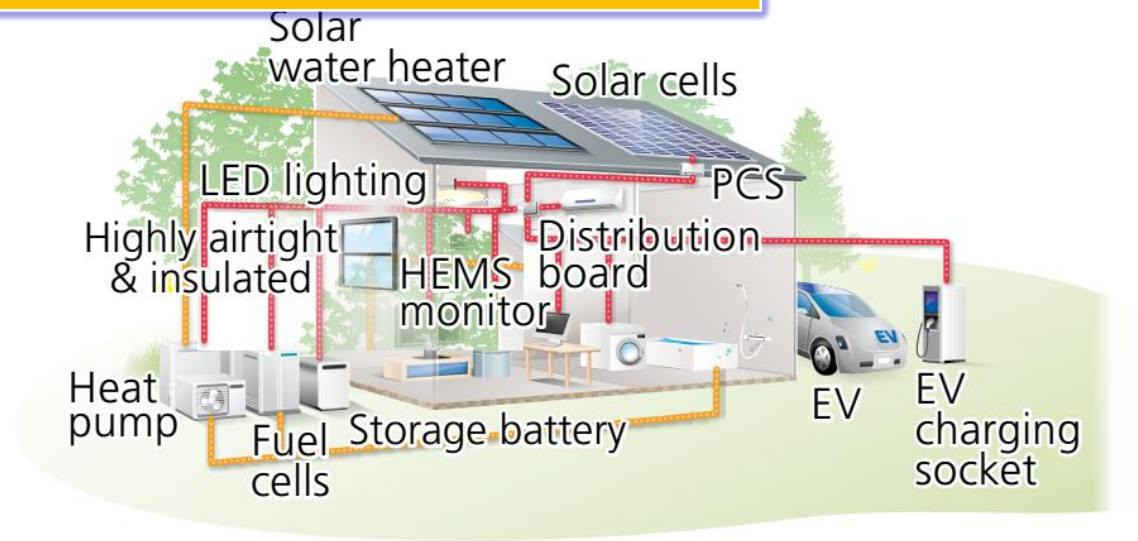
Various Institutes in Tohoku University
IFS (Institute of Fluid Science)
IMR (Institute for Materials Research)
IMRAM (Institute of Multidisciplinary Research for Advanced Materials)
WPI (World Premier International Research Center)
NICHe (New Industry Creation Hatchery Center)

Target: Stand-alone energy system for resilient society

Infrastructure-free energy system which can work in disaster

Electric car equipped with stand-alone energy system

Stand-alone energy system for house



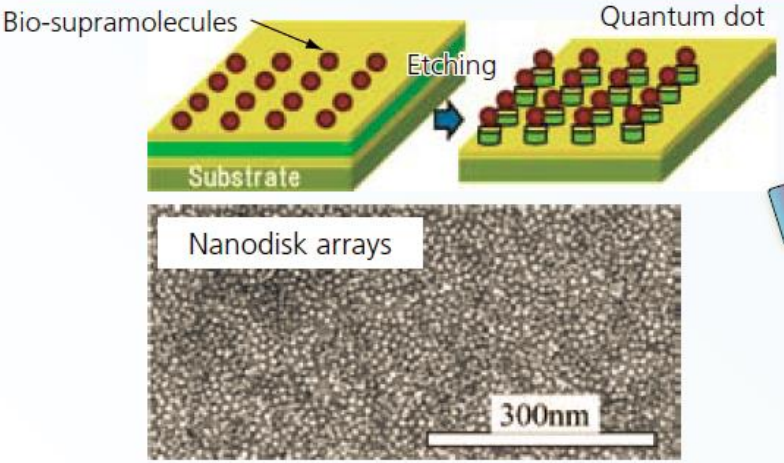
Japan as Energy Technology Nation

Market is worldwide: South-East Asia and Africa, not only Japan

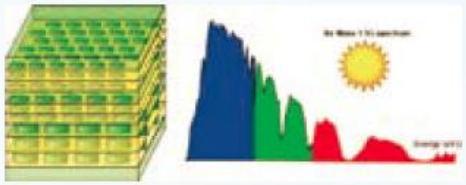
Research (1)

Solar cells

Biotemplate ultimate processing technologies



Silicon quantum dot tandem solar cells

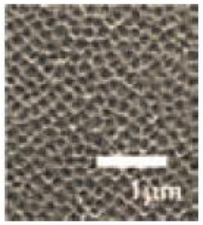


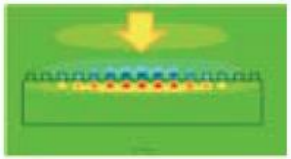
- Effectively use the spectrum of solar radiation
- Seek to improve energy conversion efficient by more than 30%

Ultra-efficient solar cells

Photonic nanostructure fabrication technologies

p-Si (100) substrate





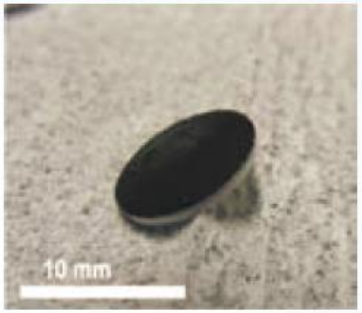
Localization of incident light near substrate surface

Seek to increase energy conversion efficiency to 40% or more

Research (2)

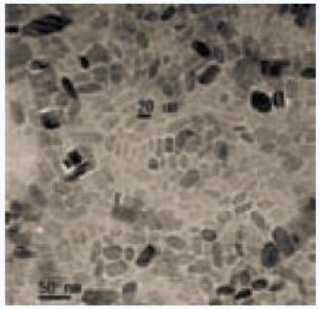
Secondary batteries

Solid-state lithium batteries



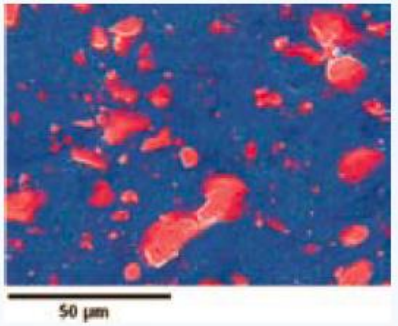
Lithium-ion batteries with high level of safety

Nanocrystal active materials

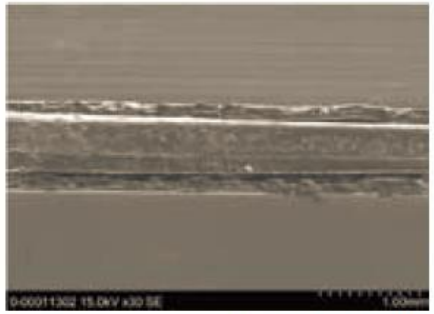


Obtain high-capacity output property with nanocrystal electrodes

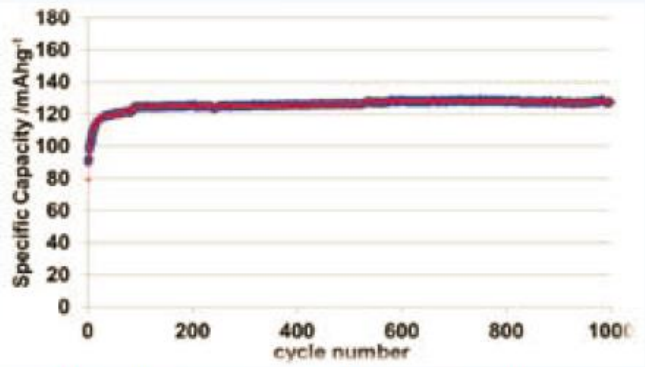
Ion liquid/solid electrolyte



Organic solid-state lithium batteries



Aim for storage energy density of 350Wh/kg



Solid-state battery recharge/discharge cycle properties

Research (3)

Fuel cells

Improve convenience of fuel cells (SOFC/PEFC) by controlling nano interfaces

- Build ion functional interfaces through interface composition and structure control
- Design and build nano structure energy storage materials and new catalysts
- Multiple first-principle analyses & thermodynamic data

Create new integrative technologies

Li B $H_{cov.}$

Complex system
Reactivity △
Hydrogen density ◎

H_2

Reaction analysis
Interface design
Interface visualization

$LiBH_4 \underset{\text{Rehydrogenation}}{\overset{\text{Dehydrogenation}}{\rightleftharpoons}} LiH + B + 3/2\ H_2$

Solar cells

Fuel cells and Secondary batteries

Seeds 1: Multiple first-principle calculations (simultaneous calculations of multiple conditions)
Seeds 2: Design of materials based on non-stoichiometric oxygen and thermodynamics data

Development and understanding of reactions of new electrode materialsImprove electrode performance by optimizing composition and structure.

Seeds 3: Construction of high ion function interfaces through control of nano interfaces.
Seeds 4: Technologies utilizing hydrogen

Goal (SOFC) / current state → 3rd year
Generating efficient: Sustain 50%
Operating temp: 800˚C → 600˚C

Goal (PEFC) / current state → 3rd year
Generating efficient: Propose 4 → 50%
Use of hydrogen storage materials

Research (4)

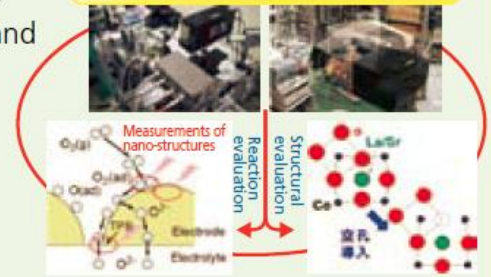
Analysis & optimization

Nano interfaces and their evaluation, and theoretical analysis of nano-structures

Basic technologies

1. Nano interfaces and their evaluation technologies
2. Nano-structure analysis technologies

Measurements of nano-structures

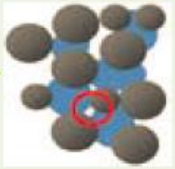


3. Mathematical analysis

Oxygen of catalytic layer ionomer Evaluation simulator of permeability (several nm to several 10 nm)

· Simulator of droplet transport within complex multiporous structure in water-repellent layer (several nm to several 10 nm)

Modeling scale-up



Contribute with evaluation and testing

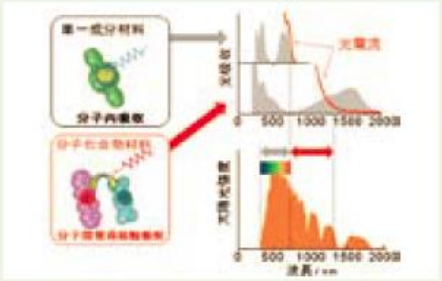
Theoretical design using optimization methods

Integrate these technologies

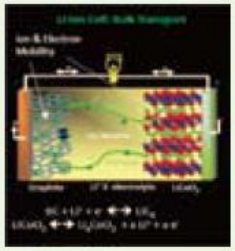
Propose next-generation smart systems

Create software for designing batteries

Software for efficient design of solar cells

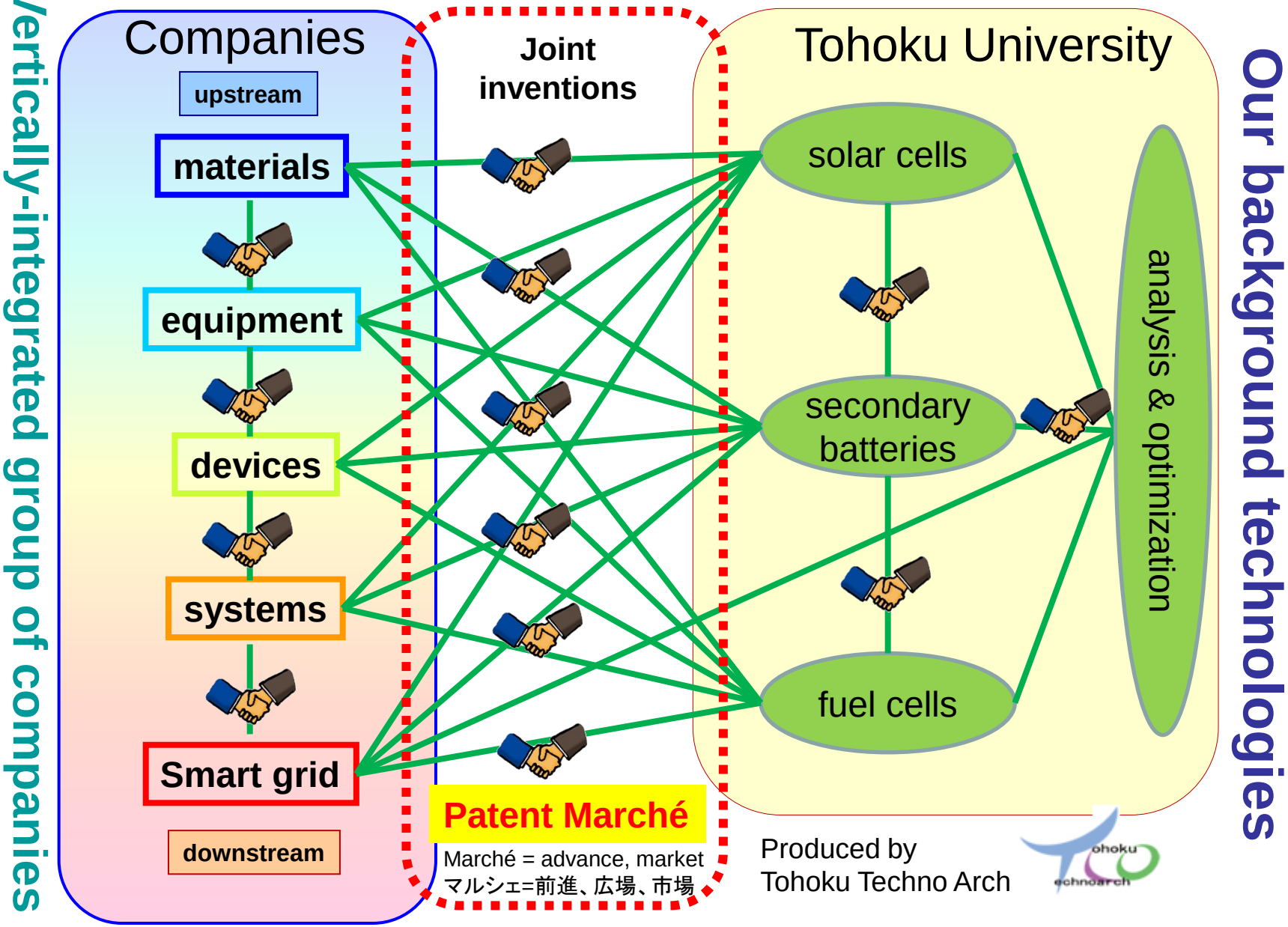


Software for efficient design of Secondary batteries



Software for efficient design of fuel cells

Strategic R&D through vertically integrated group of companies



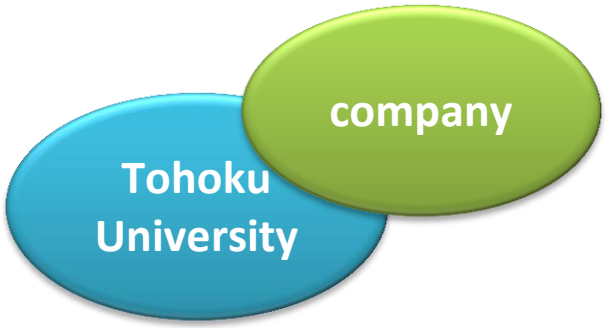
Member Companies

Step 1: 29 companies

Consortium member companies
(exchange of public and the newest information)

Step 2: 15 companies

Research collaboration companies, which can participate “Patent Marché”



Step 3: 2 groups

Formation of company groups to start business