GREEN ENERGY STORAGE and CONVERSION LABORATORY

그린 에너지 저장 및 변환 연구실

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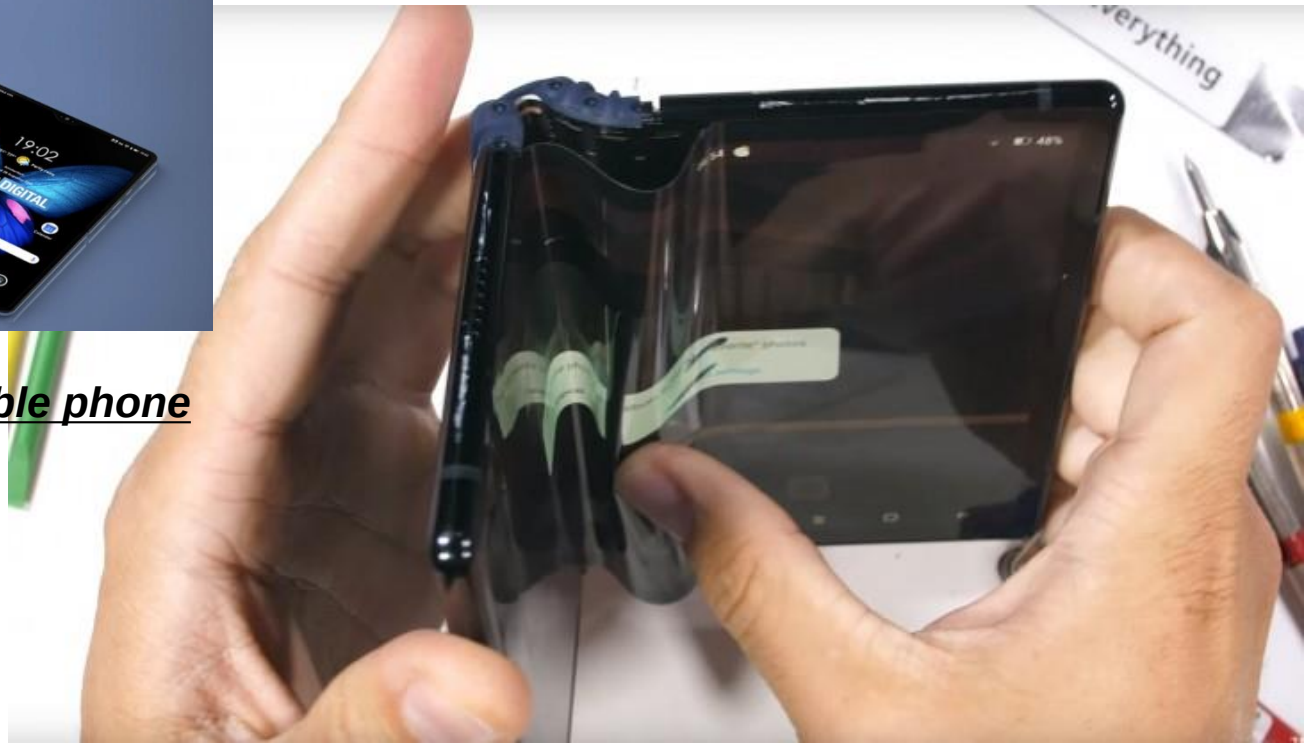
Welcome to green energy storage and conversion laboratory

We are interested in smart engineering for next generation ENERGY STORAGE AND CONVERSION systems. For energy storage systems such as rechargeable batteries, we question: How do we make them more sustainable, safe and cost-effective, and store energy in fast? These questions abstract the looks of next-generation energy technology. Though the current energy technologies have been made great of progresses on the energy storage systems, it is still far from the satisfaction for the questions. We wait for you who find the answers together. We are also interest in energy conversion systems such as fuel cells. If the batteries are now, the hydrogen would be the future. A growing body of evidence supports the decarbonation based on hydrogen. The kernel of the hydrogen based energy will be; how do we secure *'Green'* hydrogen in large scale and produce electrical energy from the *'Green'* hydrogen?

We stand on the intersection of Mechanical Engineering, Material Science Engineering, Computation and Chemical Engineering.

Area 1. Functional Electrode Material/System Design

https://www.gsmarena.com/



Current cutting-edge foldable phone

Flexible system

In terms of Energy

i) Energy Consumption

ii) Energy Storage System

iii) Frame for i and ii

Goal: Support

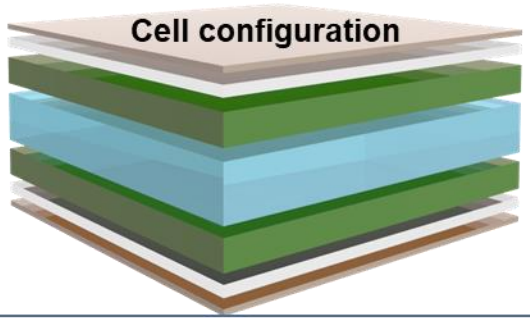
PUSAN NATIONAL UNIVERSITY
SCHOOL OF MECHANICAL ENGINEERING

Area 1. Functional Electrode Material/System Design

[Key words]
- Flexible supercapacitor/batteries
- material mechanics
- Electrochemistry
- interface design

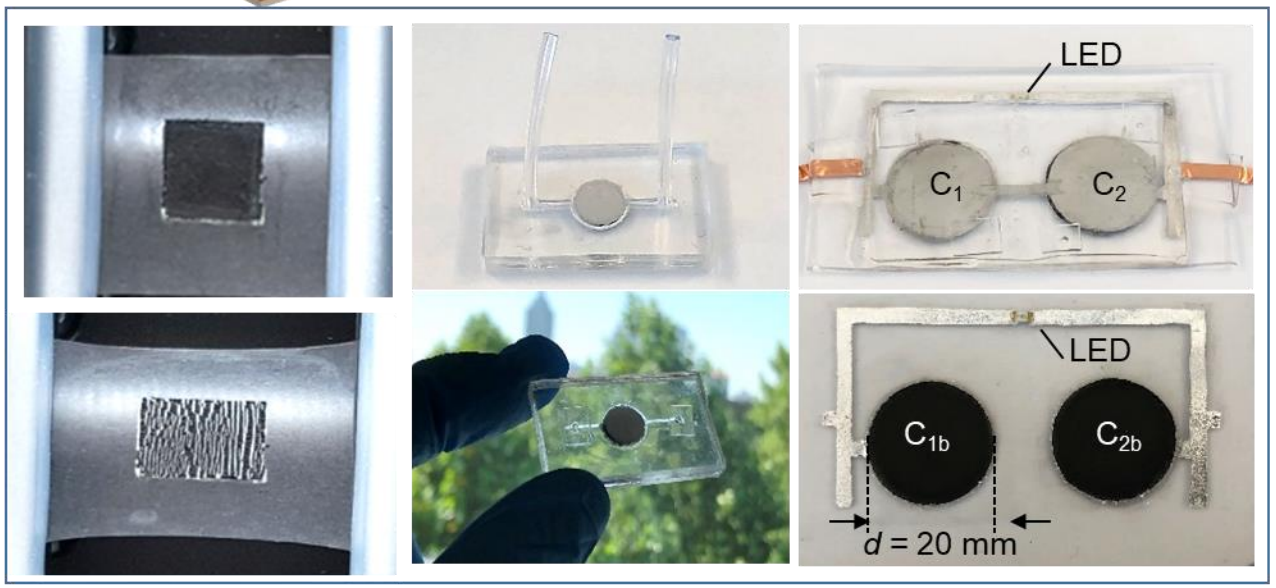
[Contents]
- Development of interaction free system to avoid mismatch of mechanical properties at interfaces.
- Stretchable metal electrode

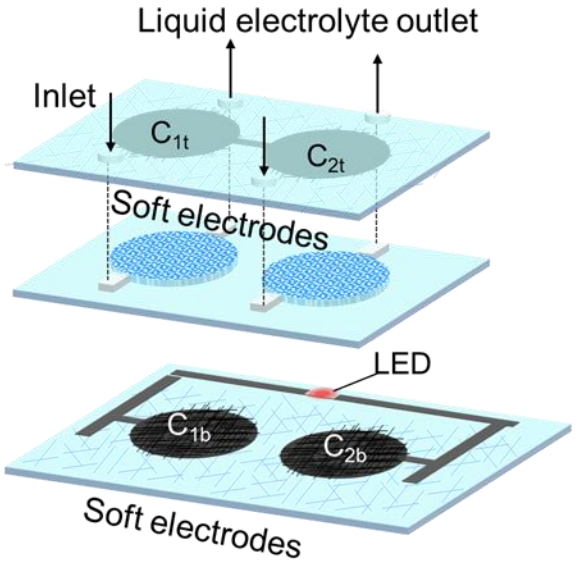
❖ Soft energy storage system



For stretchable system,

Interaction free



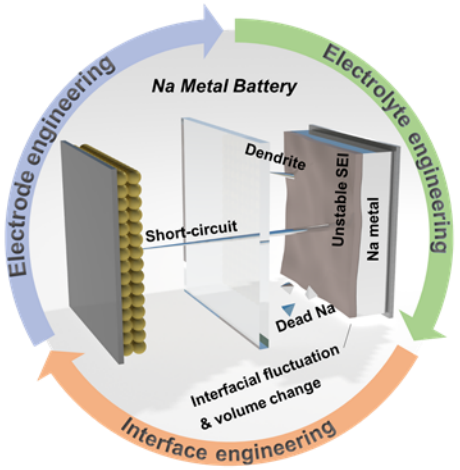


Area 2. Next-Generation Electrode Materials

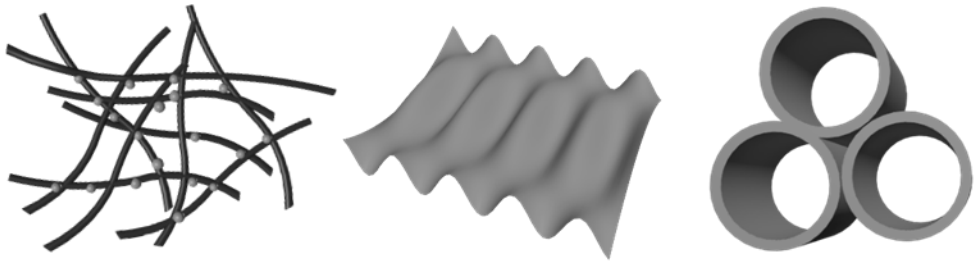
[Key words]
- High performance
- Sustainable
- Nanostructured material
- Mechanical stability

[Contents]
- Development of electrode based on alkali metal
- Integration with high performance cathode type (e.g., S, Se, air, etc.)

❖ Alkali metal electrode

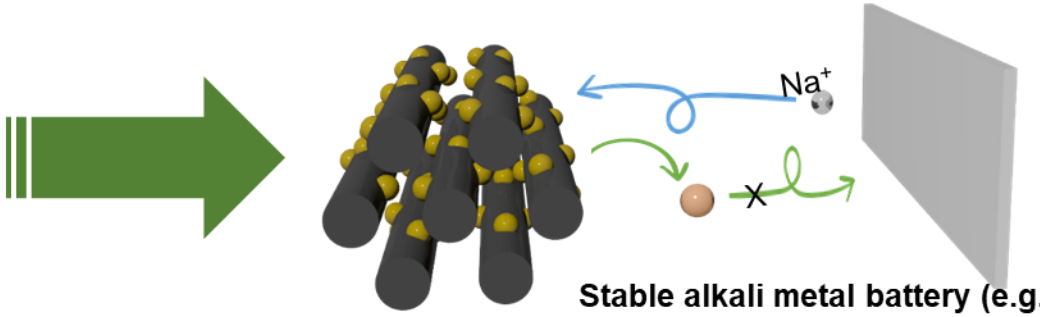


Strategy to provide comprehensive solutions at anode side



Various carbon host structures for alkal metal & cathode materials

Strategies to address the issues on the cathode side



Stable alkali metal battery (e.g., Na-S,Se)

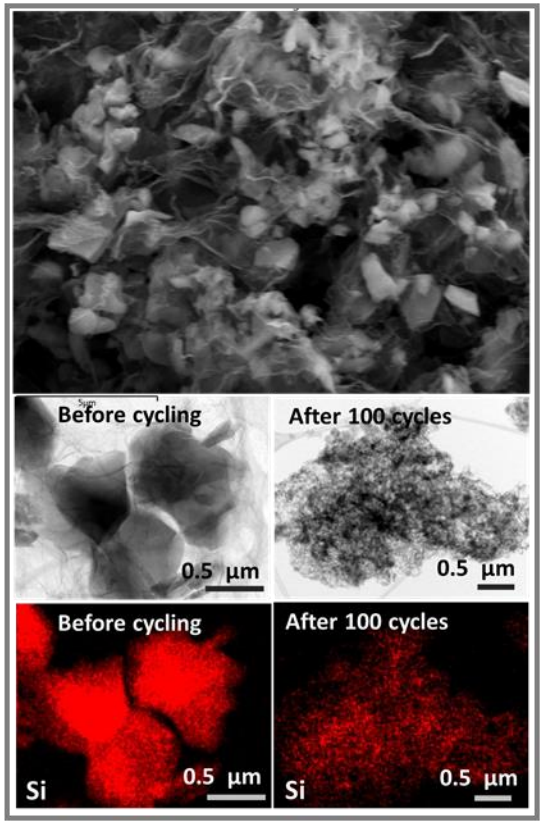
Candidate for Next-Generation ESS

Area 3. Nanostructure Control for Electrode Materials

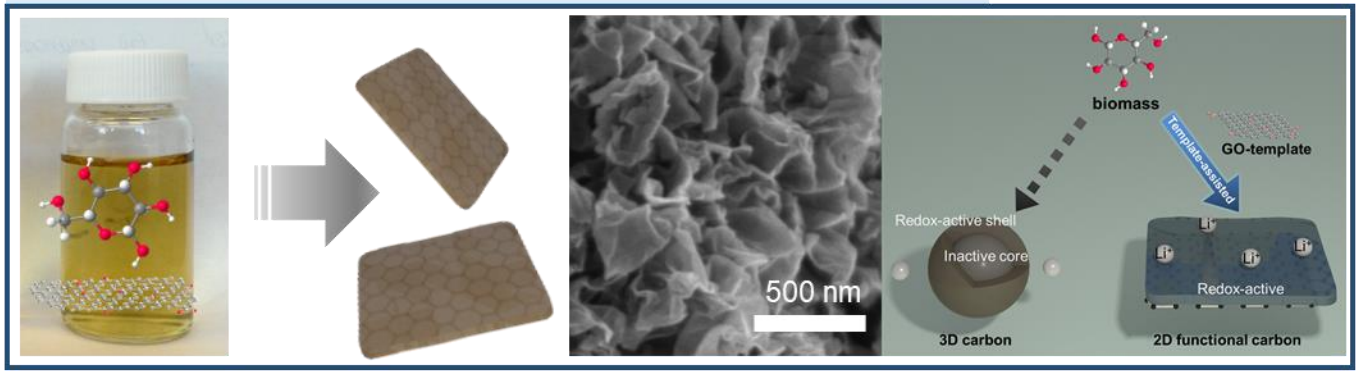
[Key words]
- High Performance
- Material Design
- Nanotechnology
- Electrochemistry

[Contents]
- Development of high performance electrode materials through nanostructure control.
- Long lifetime, fast charge storage

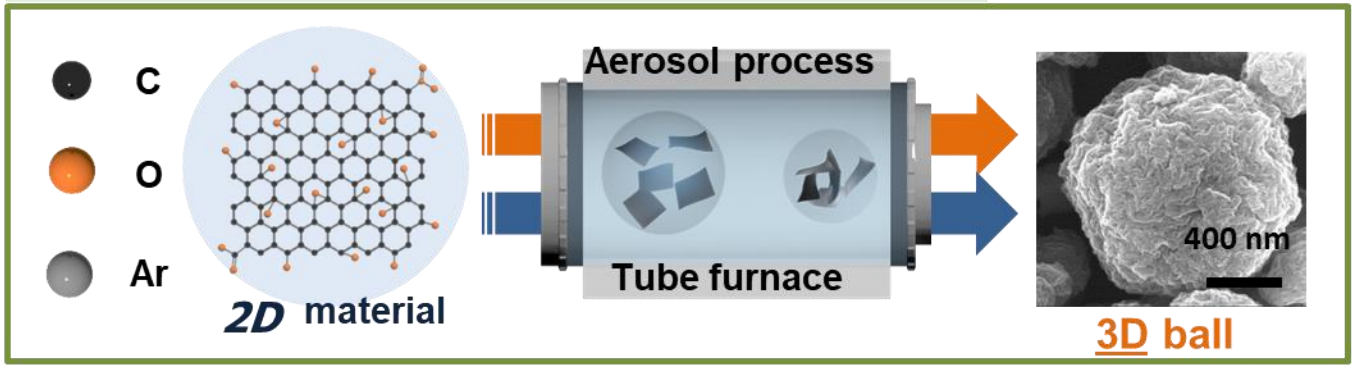
(i) Encapsulation



(ii) 2D morphology: Ultrathin functional carbon film



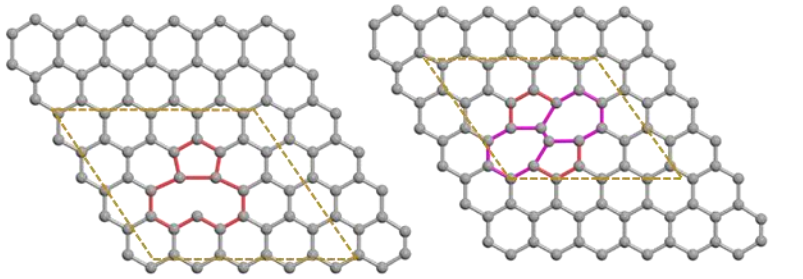
(iii) 3D morphology: Ultrathin functional carbon film



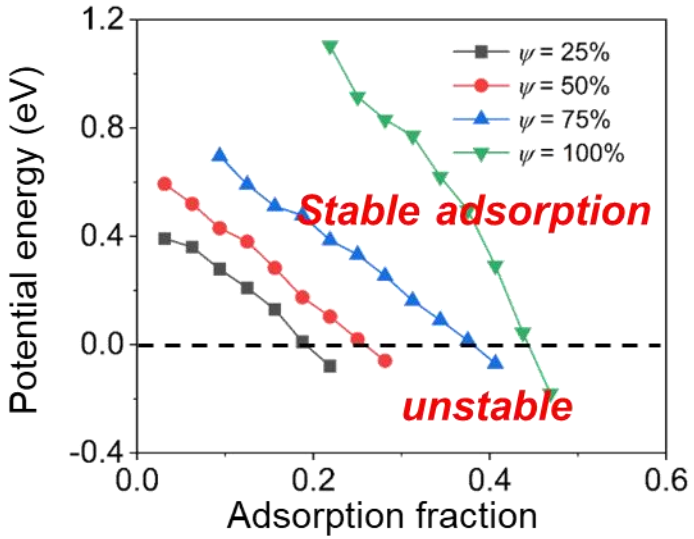
Area 4. Material computation: Properties & behavior

[Key words]
- Molecular dynamics
- Density Functional Theory
- Atomic scale
- Ion adsorption

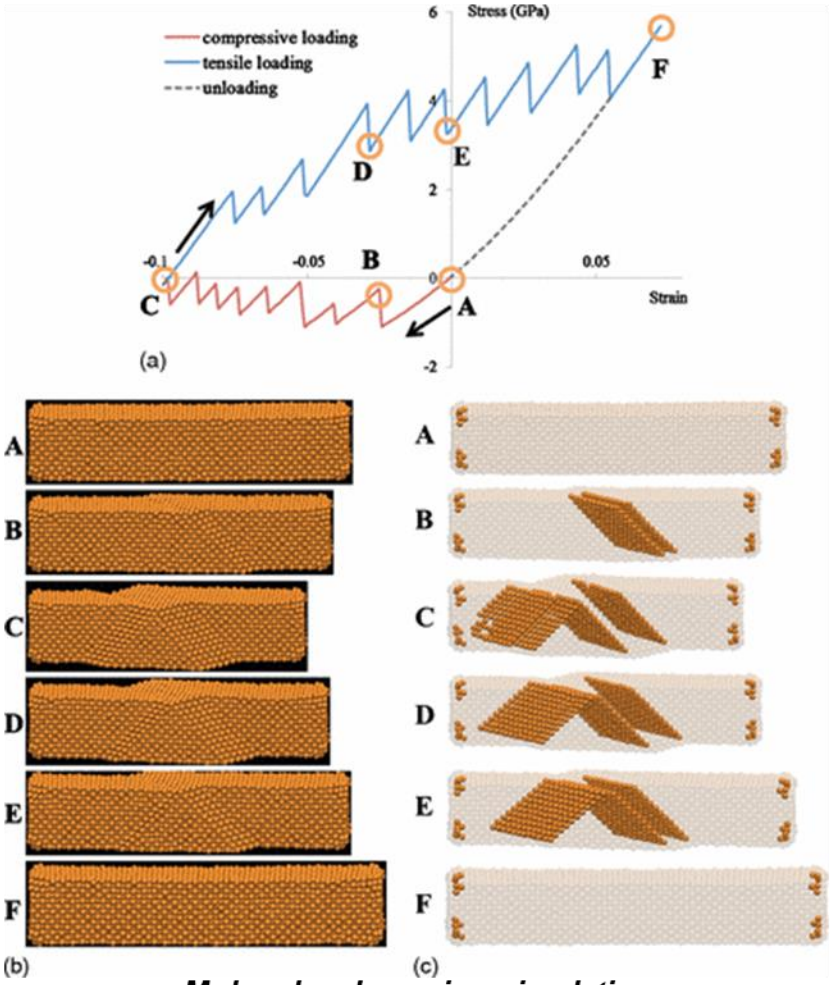
[Contents]
- Investigation of ion adsorption to with thermodynamic stability
- Material behavior under mechanical load



Single vacancy (SV) Stone-Wales (SW)



Density functional theory calculation



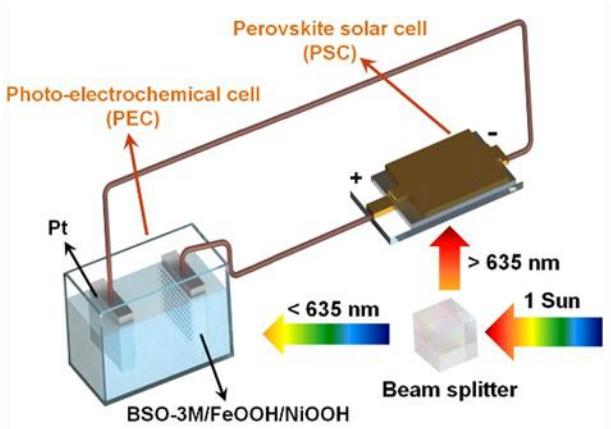
Molecular dynamics simulation

Area 5. Catalysts

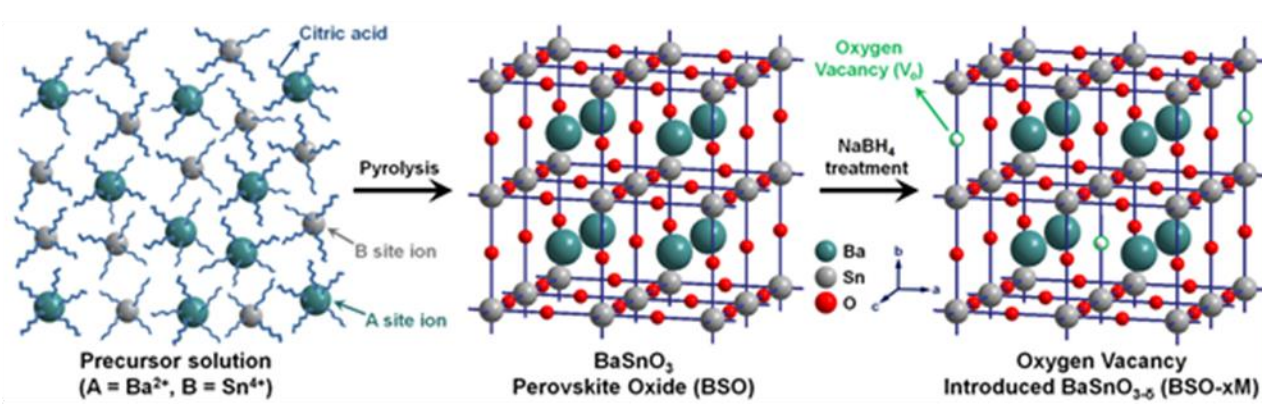
[Key words]
- Hydrogen evolution/Oxygen evolution
- Photoelectrochemical water splitting
- Electrocatalyst
- Bandgap

[Contents]
- Bandgap adjustment by defect introduction
- Effective utilization of pyrochlore oxide support by the efficient electron transport

Bandgap adjustment by defect introduction for photoelectrochemical (PEC) water-splitting



Water-splitting cell



Introduction of oxygen-vacancy on ABO_3

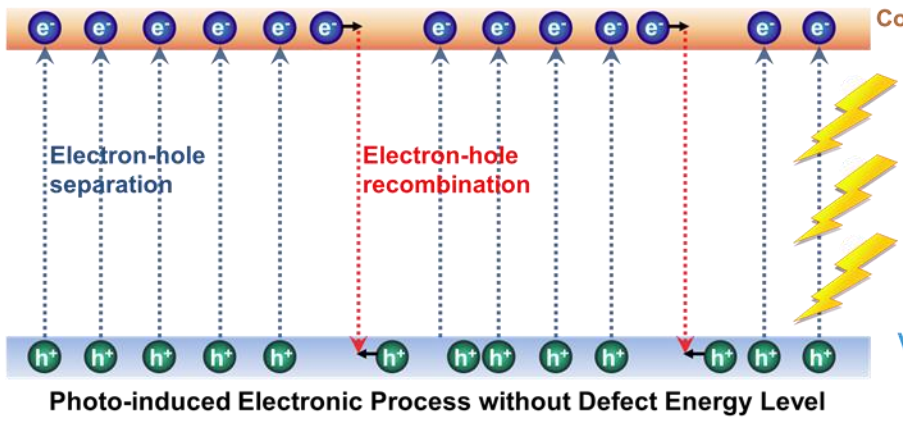


Photo-induced Electronic Process without Defect Energy Level

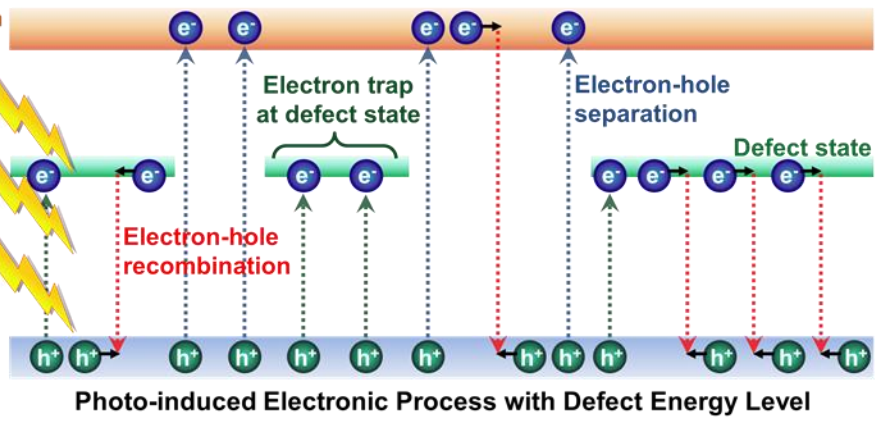
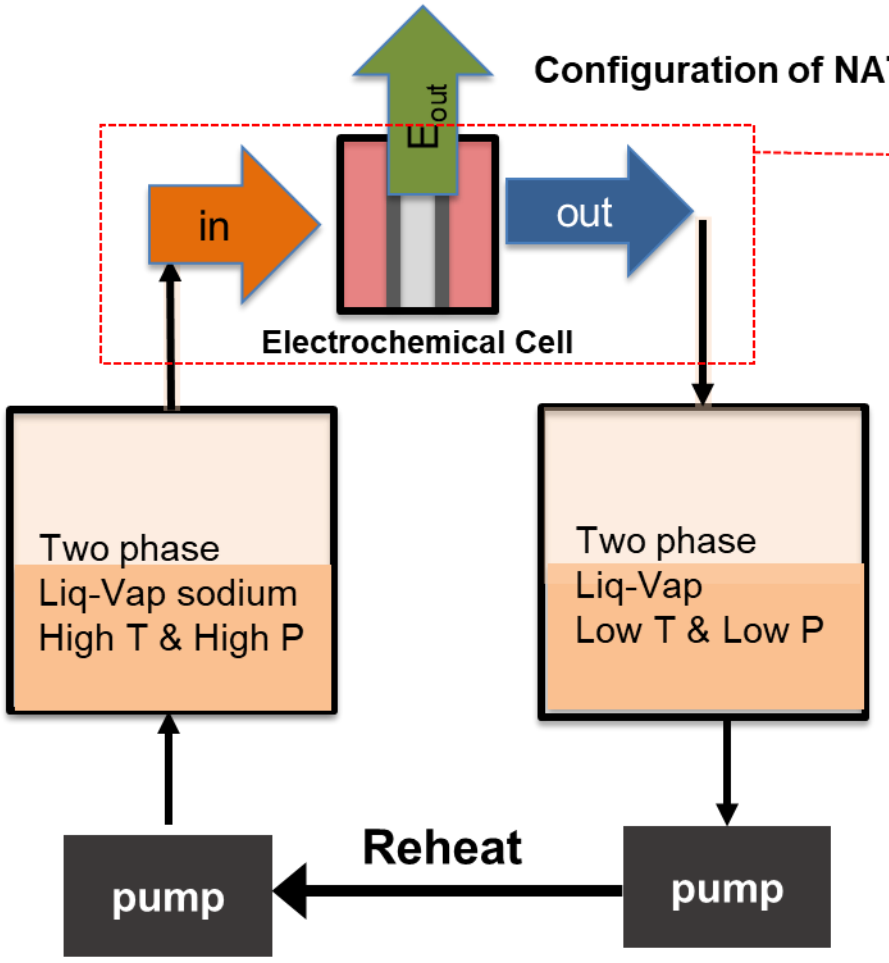


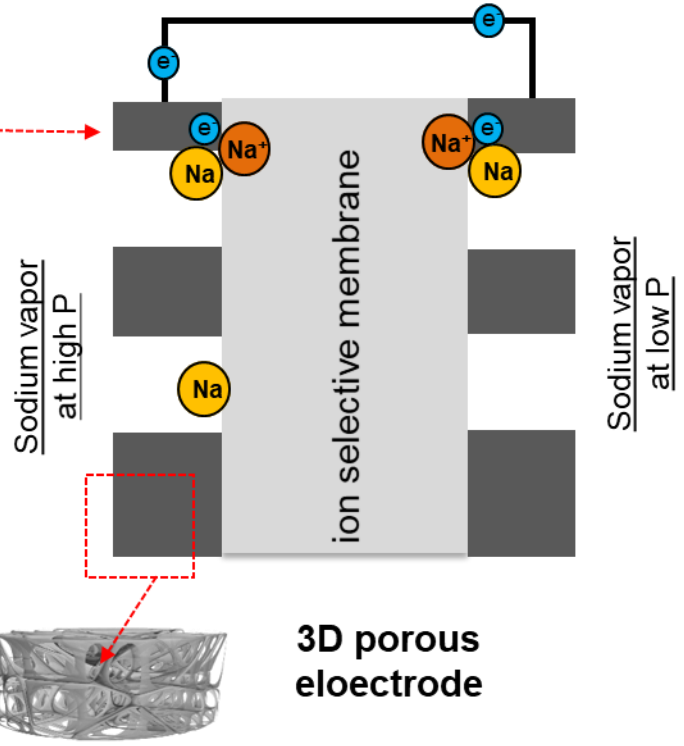
Photo-induced Electronic Process with Defect Energy Level

Area 6. NATEC: Sodium Vapor ➔ Electricity

[Key words]
- High performance
- Sustainable
- Nanostructured material
- Mechanical stability

[Contents]
- NATEC is the direct convertor thermal to electric enerDevelopment of electrode based on alkali metal
- Integration with high performance cathode type (e.g., S, Se, air, etc.)





- **Stable operation**
- **Direct pressure drop ~ vapor bypass → Sealing**