세종대학교 SEJONG UNIVERSITY

ENERGY MATERIALS LAB

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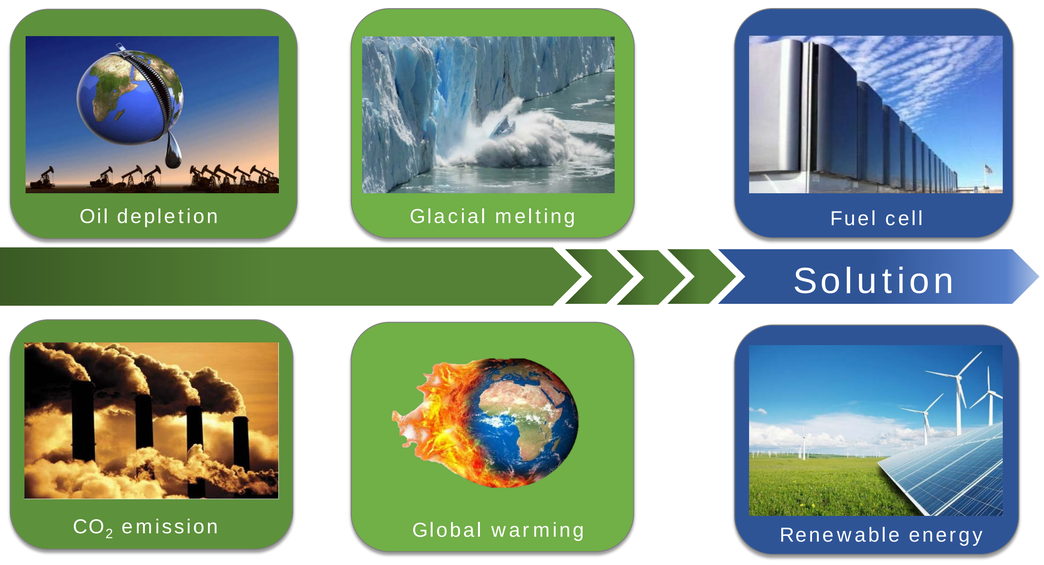
Introduction

Energy Materials & Fuel Cell

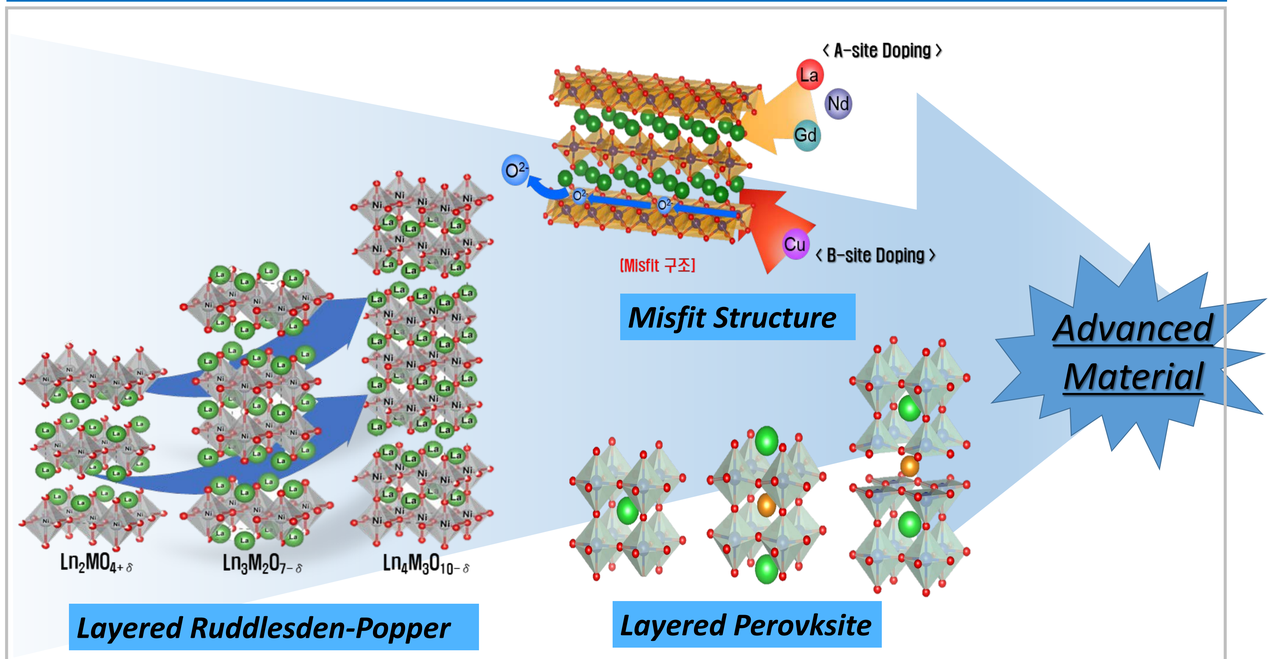
Background of introduction 'Energy Materials'



Explanation

Particulate air pollution has been much more serious worldwide compared to past. And also as scientific development is growing rapidly, the fuel such as oil becomes depletion. To get out this crisis, eco-friendly fuels are began to introduce as alternative fuels. One of eco-friendly fuel is based on "Fuel cell".
Fuel cell is an electrochemical cell that converts the chemical energy from a fuel into electricity through an electrochemical reaction of hydrogen fuel with oxygen or another oxidizing agent. Fuel cells are different from batteries in requiring a continuous source of fuel and oxygen (usually from air) to sustain the chemical reaction, whereas in a battery the chemical energy comes from chemicals already present in the battery. Fuel cells can produce electricity continuously for as long as fuel and oxygen are supplied.

Advanced Energy Material Research



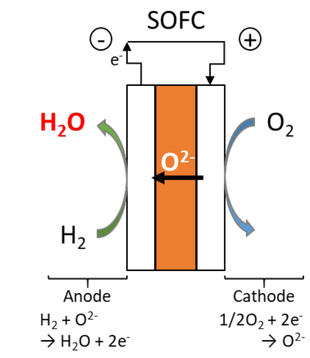
Explanation

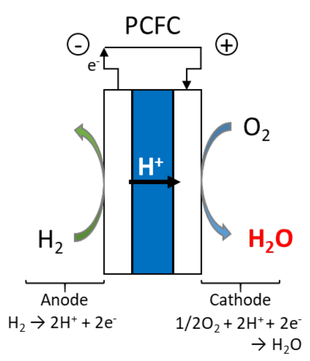
For developing advanced energy materials, it needs to discover new materials. Previous material research for the energy conversion devices has been limited for performance and durability because of sluggish intrinsic properties. For this reason, the advanced material, which is applied for energy devices will be discover our research group such as layered perovskite, misfit layer and layered Ruddlesden-Popper structure etc.

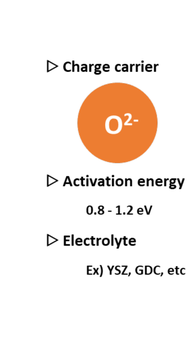
Research Field

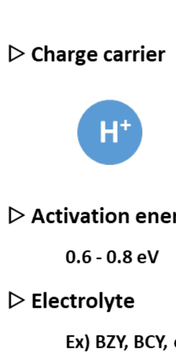
Solid Oxide Based Fuel Cell

Solid Oxide Fuel Cell (SOFC) & Protonic Ceramic Fuel Cell (PCFC)









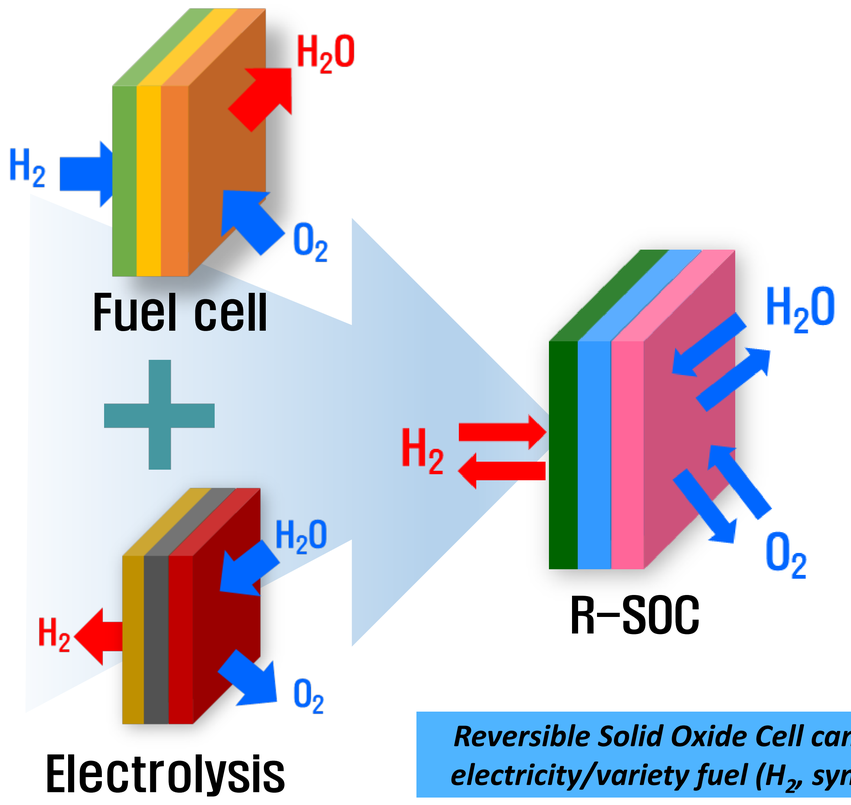
Solid Oxide Fuel Cell (SOFC)

A solid oxide fuel cell (SOFC) is an electrochemical device to generate electricity directly. The advantages of SOFCs has high efficiency, flexibility of fuel, long-term stability, and relatively low cost.

Protonic Ceramic Fuel Cell (PCFC)

A protonic ceramic fuel cell or proton conducting fuel cell (PCFC) is a type of SOFCs based on a ceramic electrolyte. PCFCs are being developed which transport protons instead of oxygen with advantage of being able to be run at lower temperatures than traditional SOFCs.

Reversible Solid oxide cell (R-SOC)



Reversible Solid Oxide Cell can produce electricity/variety fuel (H_2, syn gas etc.)

Water Splitting Catalyst & Polymer electrolyte membrane fuel cells (PEMFCs)

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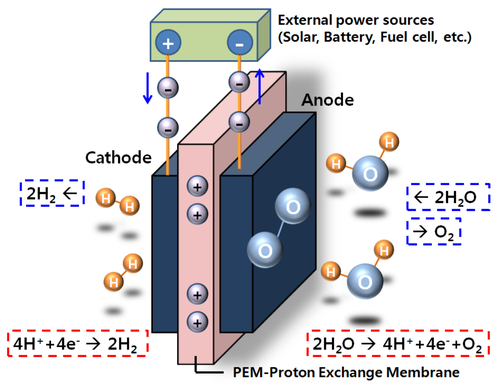
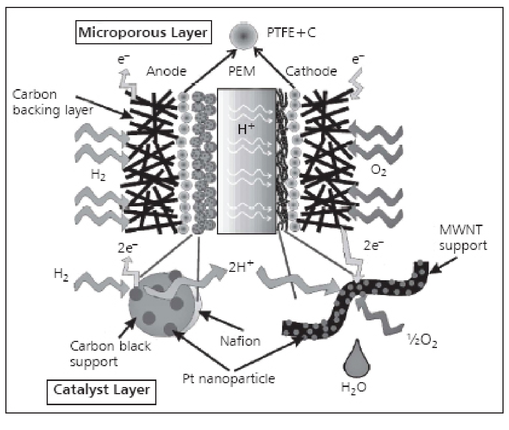


Water Splitting Catlayst

Noble metal catalysts have disadvantage for making commercialization of such electrochemical devices in terms of high cost and limited durability. So, to achieve high efficient electrocatalyst for OER & ORR, various nanostructured metal oxide catalysts are synthesized by the hydrothermal method.



Polymer electrolyte membrane fuel cells (PEMFCs)

Proton exchange membrane fuel cells, also know as polymer electrolyte membrane fuel cells (PEMFCs) are a category of fuel cell. Direct-methanol fuel cells (DMFCs) are a subcategory of PEMFCs. The methanol is used as the fuel that is different with PEMFCs.

Recent Publication

1. K.-Y. Park, Y.-D. Kim, J.-I. Lee, M. Saqib, J.- S. Shin, Y. Seo, J.H. Kim, H.T. Lim, J.-Y. Park, Acs Appl Mater Inter, (2018)
2. N.-I. Kim, Y.J. Sa, T.S. Yoo, S.R. Choi, R.A. Afzal, T. Choi, Y.-S. Seo, K.-S. Lee, J.Y. Hwang, W.S. Choi, ***Science Advances***, 4 (2018) eaap9360.
3. Y.-D. Kim, J.-I. Lee, M. Saqib, K.-Y. Park, J. Hong, K.J. Yoon, I. Lee, J.-Y. Park, J Electrochem Soc, 165 (2018) F728-F735.
4. N.-I. Kim, S.-H. Cho, S.H. Park, Y.J. Lee, R.A. Afzal, J. Yoo, Y.-S. Seo, Y.J. Lee, J.-Y. Park, J Mater Chem A, 6 (2018) 17807-17818.
5. Y.-D. Kim, J.-Y. Yang, J.-I. Lee, M. Saqib, J.-S. Shin, M. Shin, J.H. Kim, H.-T. Lim, J.-Y. Park, J Alloy Compd, 779 (2019) 121-128.