YAGI LAB.

Let's Think! The Science of Rechargeable Batteries

Department of Materials and Environmental Science
Research Center for Sustainable Material Energy Integration

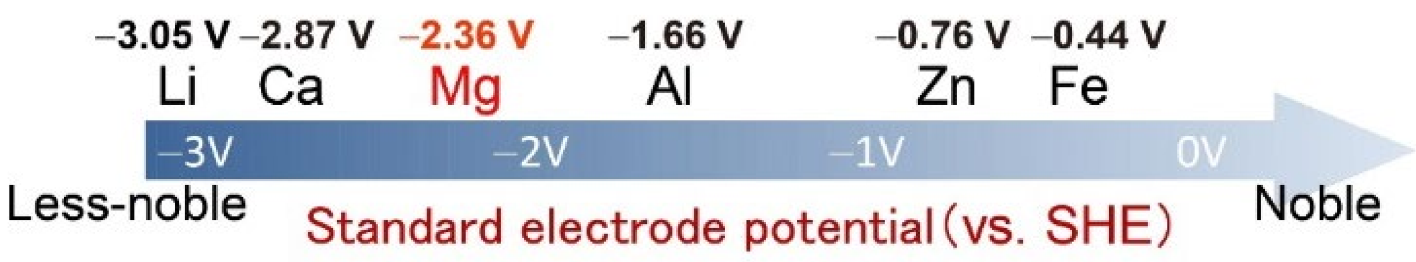
Materials Electrochemistry, Energy Conversion/storage Materials, Wet Surface Treatment.
Department of Materials Engineering, Graduate School of Engineering
https://www.yagi.iis.u-tokyo.ac.jp/en/

Innovative Rechargeable Batteries and Highly Efficient Electrochemical Processes

Yagi laboratory has developed rechargeable batteries based on novel ideas and highly-active electrochemical catalysts composed of abundant elements for the growth of the sustainable society.

Magnesium Rechargeable Battery

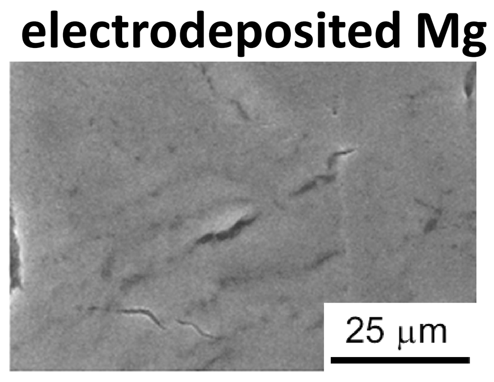
Magnesium has two valence electrons and the lowest standard electrode potential among the metals usable in air. The electrochemically deposited magnesium surface tends to be flat. We investigate magnesium battery technologies to achieve rechargeable batteries with high energy densities that permit easy handling.



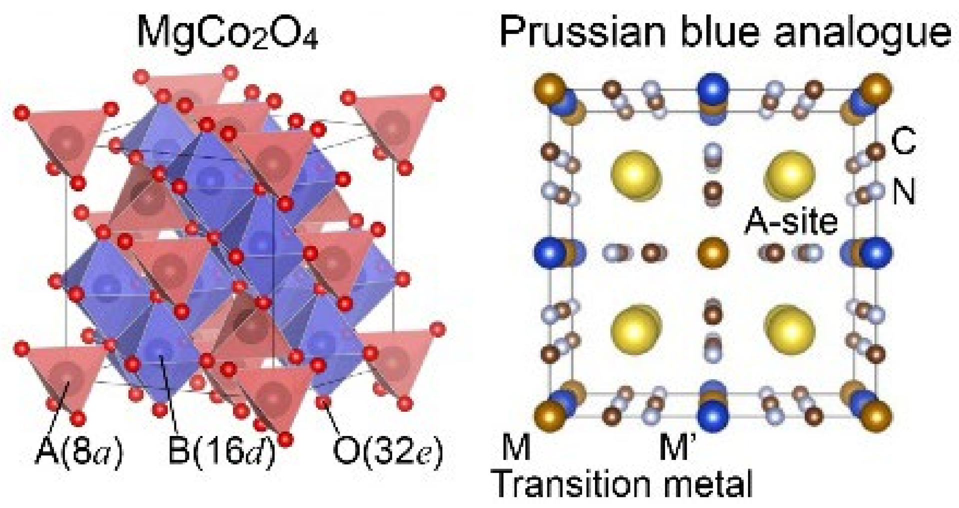
High capacity of Mg

	Potential (V vs. SHE)	Capacity (mAh/g)	Capacity (mAh/cc)
Mg	−2.36	2200	3830
LiC_6	−2.8	372	841
Li	−3.05	3860	2070

Flat surface of the electrodeposited Mg

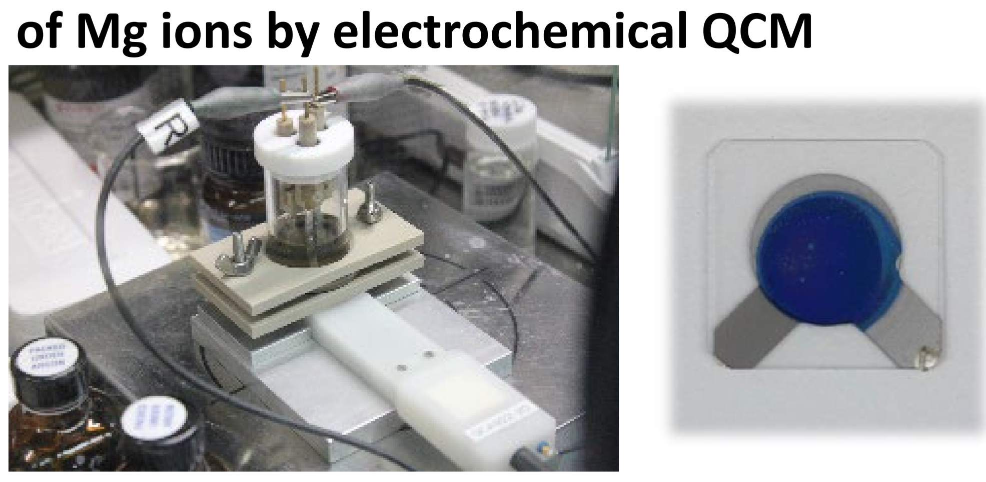


Candidates for the positive electrode



Prototype of the Mg battery

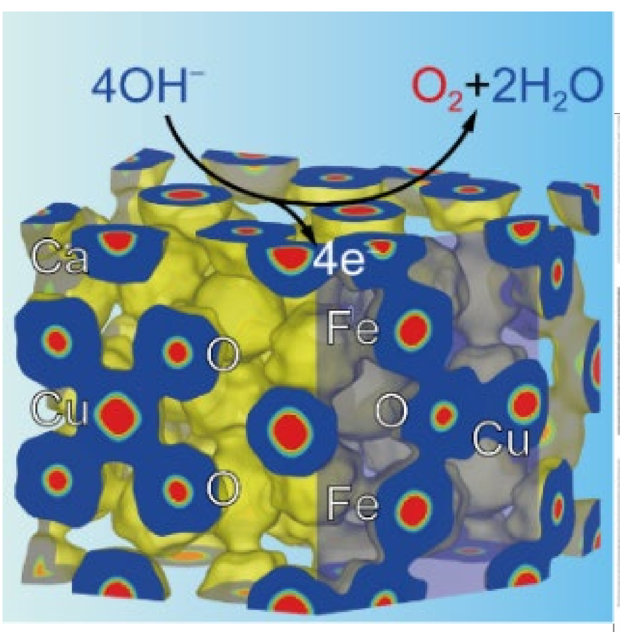
Analysis of the insertion/extraction behavior of Mg ions by electrochemical QCM

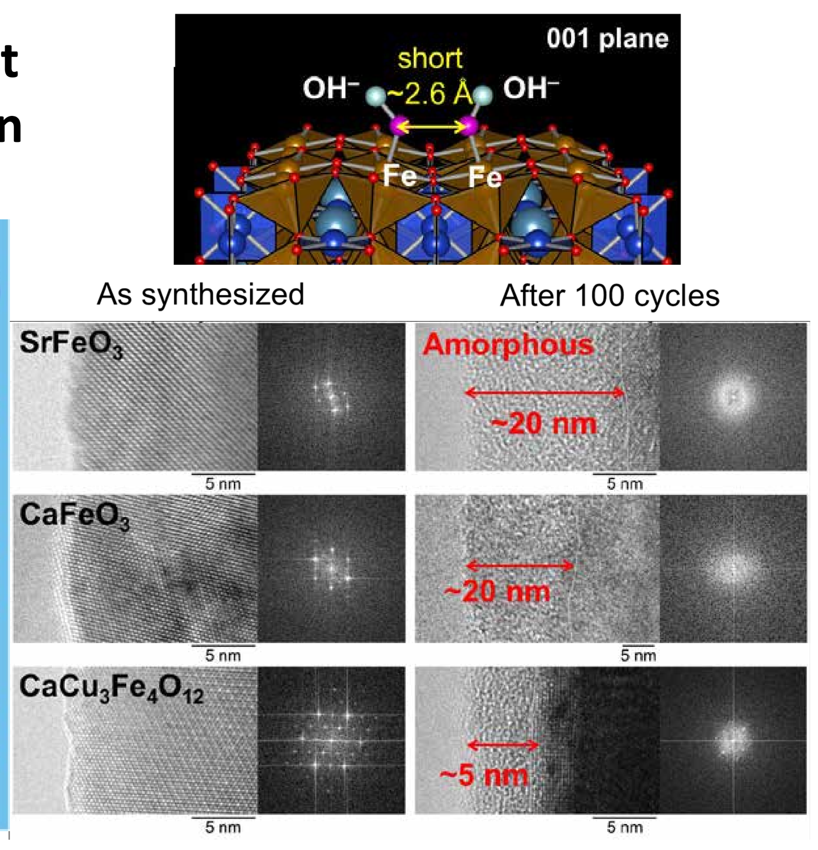


Catalysts for Oxygen Electrochemical Reactions

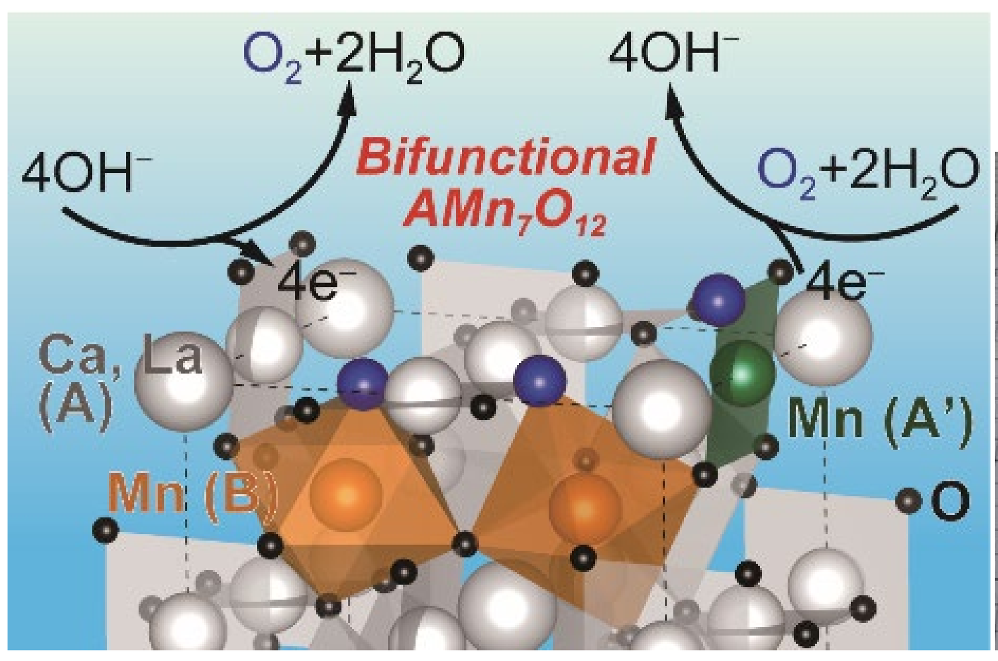
Oxygen electrochemical reactions are significantly important and utilized in fuel cells, rechargeable metal–air batteries, electrochemical water splitting with renewable energy, and electrolytic smelting. We investigate highly active catalysts that use abundant elements to promote the oxygen electrochemical reactions.

Highly active oxide catalyst $CaCu_3Fe_4O_{12}$ for the oxygen evolution reaction





Bifunctional catalyst $CaMn_7O_{12}$ active for both the oxygen evolution and reduction reactions



Prototype of the metal–air battery