

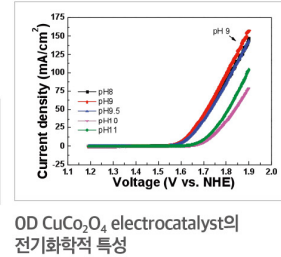
# 전기분해 응용 장치기술

## Technology for water electrolysis

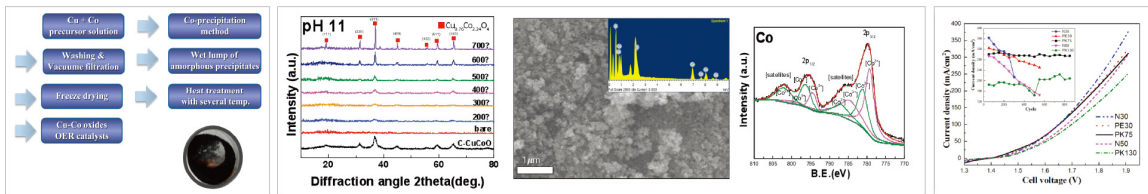
TRL3

### 기술내용

- 비귀금속 또는 비귀금속 산화물 수소 및 산소 발생 나노 구조(0D, 1D) 촉매 합성
- 고효율성, 고내구성인 수소생산용 AEM 방식 스택(stack) 제조
- 저온형 음이온교환막(AEM, anion exchange membrane) 물 전기분해 장치



- 습식공정을 기반으로 하는 비귀금속 0D, 1D 나노 구조 촉매 합성 방법 최적화 (Co-precipitation & Electrospinning)
- 합성된 촉매의 물리화학적/전기화학적 특성 분석
- 전극, 막전극접합체, 스택 제조
- 물 전기분해를 통한 수소생산 성능 평가



비귀금속 산화물 촉매 합성법 : co-precipitation

물리화학적 특성 분석-XRD, SME, EDS, XPS

전기화학적 성능 평가

### 우수성

- 다양한 합성 조건 screening 을 통한 최적화로 비귀금속 0D nanoparticle, 1D nanowire 합성 기술 개발
  - 입자크기 4 ~ 6 nm, 지경 100 nm, spinel 구조
- 경제성 있는 고수율의 합성법 개발
- powder type 촉매를 이용한 전극 제조 및 고성능/고내구성 membrane electrode assembly (MEA) 제작 기술 개발
- MEA 제조 기술을 바탕으로 AEM 물 전기분해 stack 설계 및 제작 기술 개발

• [특허] KR10-1079689 살균수 생성모듈의 차아염소산 살균수의 생성량 증대방법

### 사업성

- 나노제품 세계 시장은 연평균 42% 증가하여 2020년에는 3조 달러를 넘어설 전망이고 현재 '선도기술 확보'에서 '나노기술 산업화로 무게 중심이 이동하고 있음
- 촉매시장은 에너지, 정유, 석유화학, 정밀화학, 환경 산업 분야에서 꾸준히 증대하고 있으며, 촉매가격 대비 수십배 이상의 고부가가치를 보일 것으로 기대됨

#### 활용분야

- 비귀금속 또는 산화물 나노 구조 촉매 응용분야
- 물 전기분해 수소생산 장치
- 선박 평형수 전기분해 처리 장치
- 폐수 처리용 전기분해 장치/살균수 제조 장치

#### 기대 효과

- 귀금속 대체 촉매 개발에 따른 비용절감 및 경쟁력 강화
- 나노구조 촉매/전극 원천기술 확보
- 혁신적 전기화학 시스템 제작 기술 확보

#### 이전 가능 기술

- 비귀금속 촉매 합성 기술
- 전극/MEA/stack 제작 기술
- Stack 및 구성부품 설계 기술

# Technology for Water Electrolysis

TRL3

## Technology Overview

- Synthesis of nano-structured non-precious metal or its oxide electrocatalysts for hydrogen/oxygen evolution
- Development of highly active and highly durable anion exchange membrane (AEM) based electrolysis stack for the hydrogen production
- Water electrolysis system using AEM for low temperature operating



0D nanoparticle catalysts

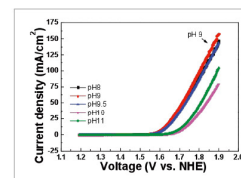
1D nanofiber catalysts

AEM water electrolysis

Alkali water electrolysis

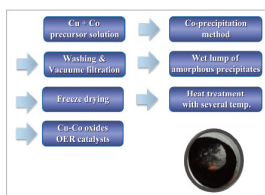
Treatment of ship ballast water

Waste water electrolysis

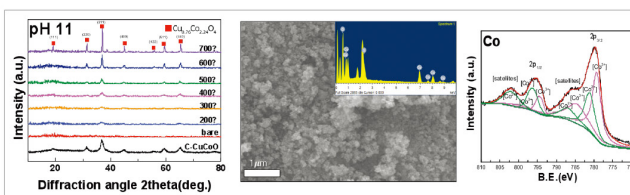


Electro-chemical properties of 0D  $\text{CuCo}_2\text{O}_4$  electrocatalyst

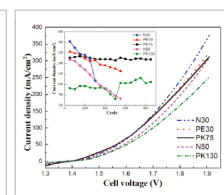
- Optimization of synthesis process for nano-structured oxide catalysts based on wet chemical process (co-precipitation & electrospinning)
- Analysis of the physiochemical/electrochemical properties of synthesized catalyst
- Fabrication of electrode, membrane electrode assembly (MEA), and stacks
- Evaluation of performance to produce hydrogen through water electrolysis



Synthesis of non-precious oxide catalyst : co-precipitation



Analysis of physio-chemical properties - XRD, SME, EDS, XPS



Electrochemical performance hydrogen evaluation

## Highlights and Strengths

- Synthesis of non-precious metal 0D nanoparticles, 1D nanowire via optimization through screening of various synthesis conditions
    - Particle size 4-6 nm, diameter 100 nm, spinel structure
  - Economically feasible method of synthesis (high yield)
  - Possible to fabricate electrodes using powder type catalyst and high performance & highly durable MEA
  - Possible to design AEM water electrolysis stacks based on MEA fabrication technology
- [Patent] KR10-1079689 MIXED METAL OXIDE ELECTRODE FOR MAKING STERILIZED WATER WITH HYPOCHLOROUS ACID AND MANUFACTURING METHOD THEREOF

## Business Cases

- The global nano product market is growing at an average of 42 percent annually and will exceed \$3 trillion by 2020. It is now shifting from developing leading nano technologies to commercializing them.
- The catalyst market is growing as demand for it is increasing in energy, oil refining, petrochemicals, fine chemicals, environment and more and is expected to create tremendous added value.

### Applicable products/services

- Catalysts of non-precious metal or oxide nano structure
- Devices producing oxygen from water electrolysis
- Devices for electrolysis for ships' ballast water
- Devices for electrolysis and sterilizers for waste water treatment

### Benefits

- Cost-saving and higher competitiveness from use of alternative to precious metals
- Proprietary technology for nanostructure catalysts and electrodes
- Technology to fabricate innovative electro-chemical systems

### Transferable technology

- Technology to synthesize non-precious metal catalyst
- Fabrication of electrodes, MEA and stacks
- Designing of stacks and components