

차세대 전기변색 슈퍼커패시터를 기반으로 한 고효율 열 에너지 차단 장치

서울시립대학교 화학공학과
FPML

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1. 연구목표

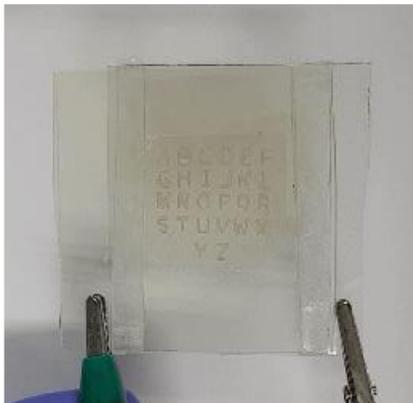
Flexible Display



Smart glass

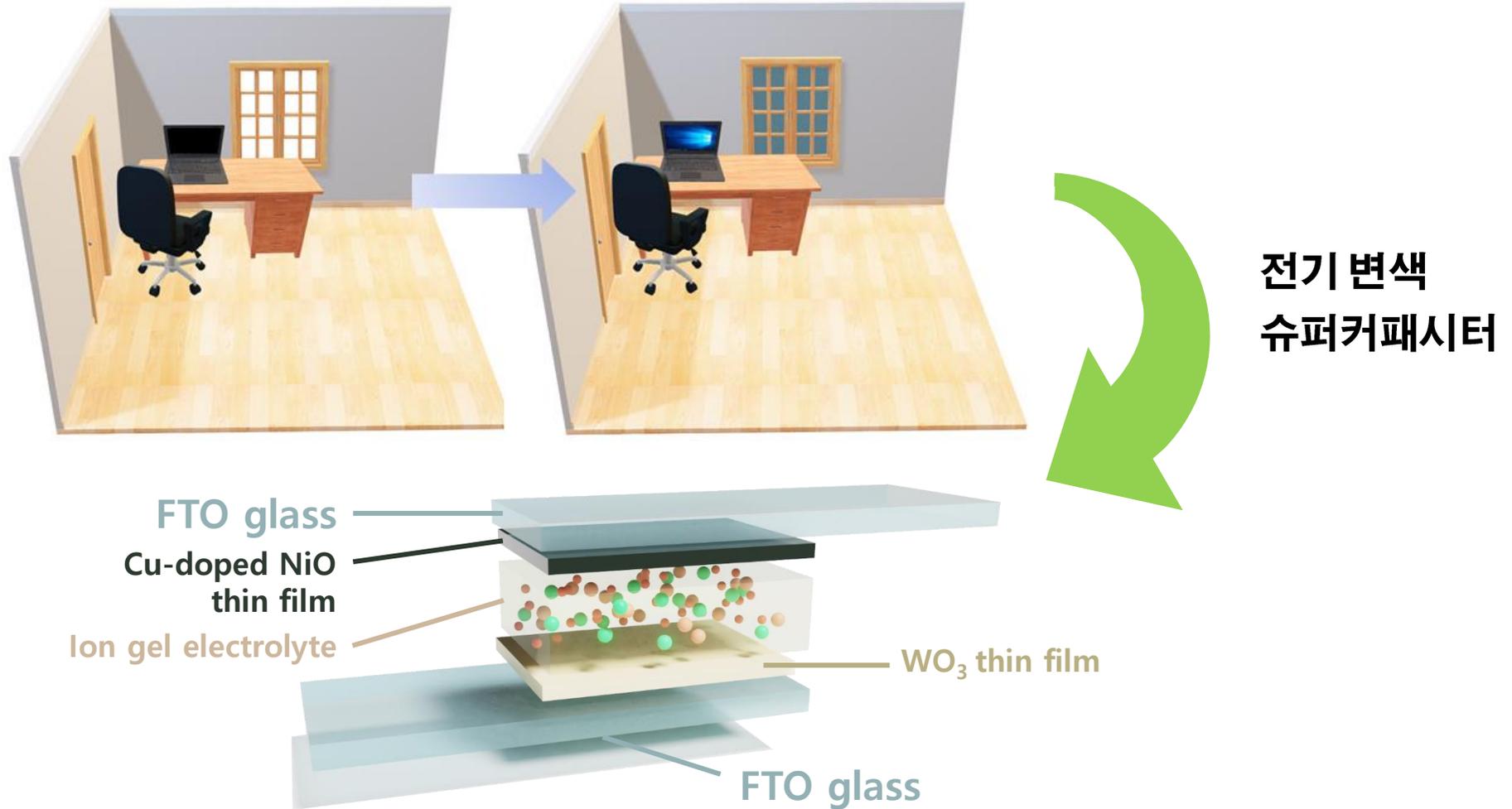


ECD의 용도는?



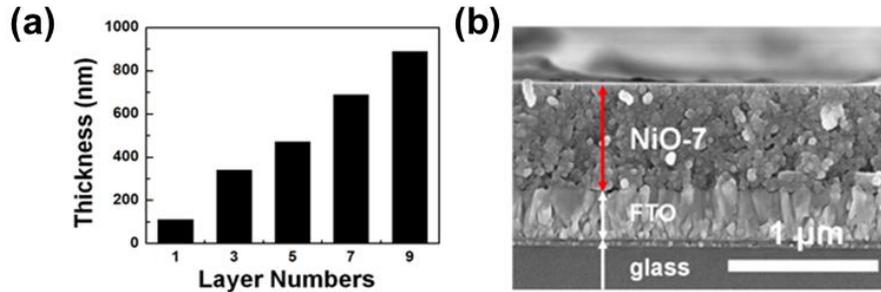
2. 연구내용

■ 전기 변색 슈퍼커패시터를 이용한 태양열 차단 장치



2. 연구내용

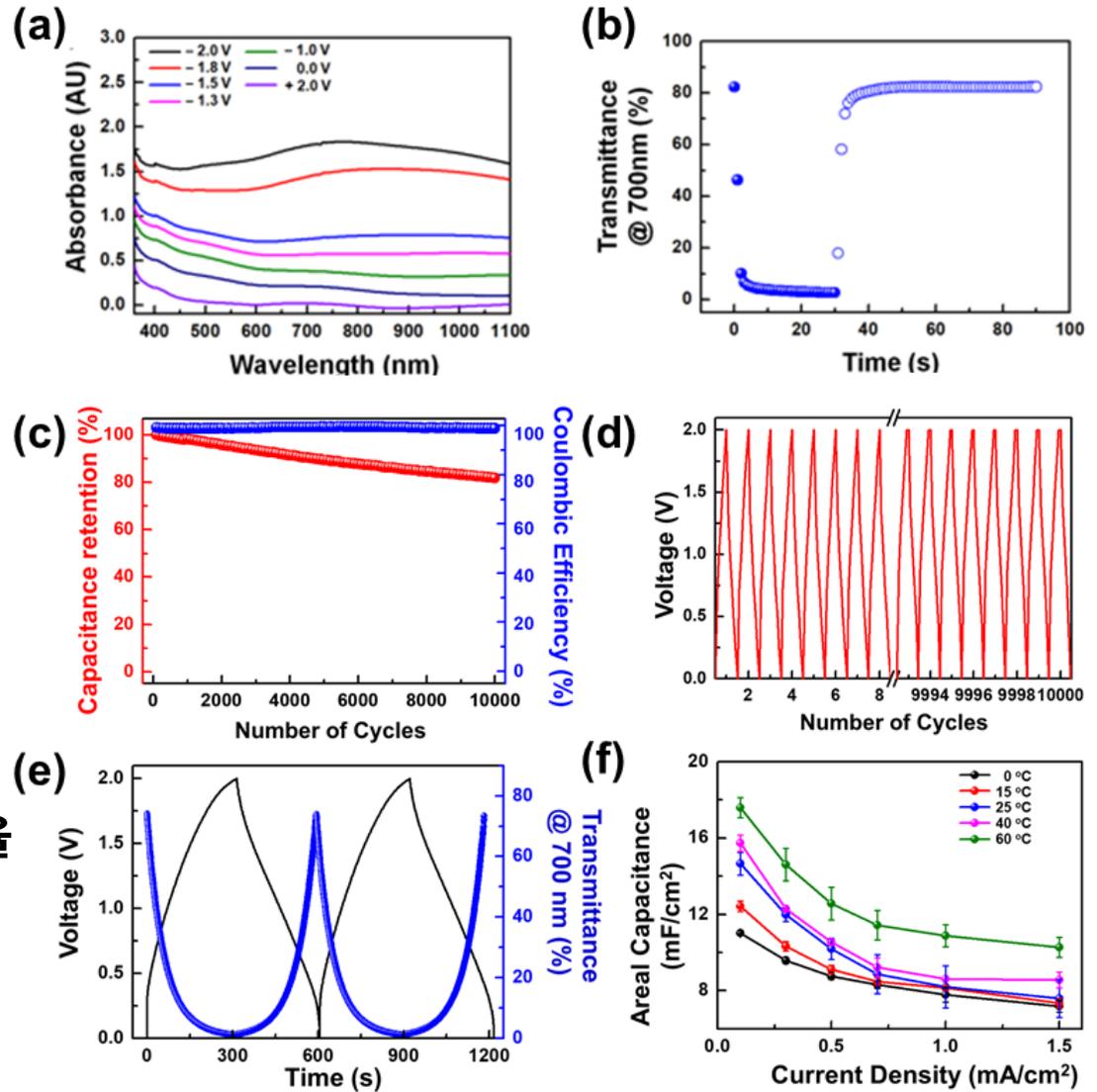
■ 슈퍼 커패시터 최적화 및 특성 측정



최적화된 NiO 두께를 가진
슈퍼 커패시터 제작

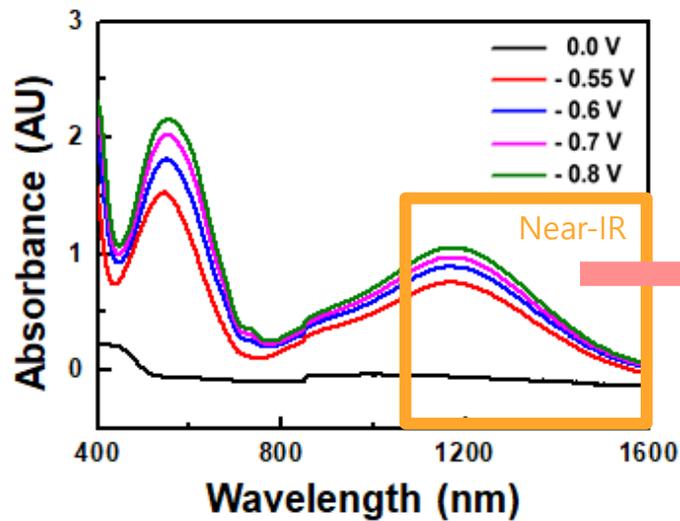


안정적인 구동과 높은 방전 효율



2. 연구내용

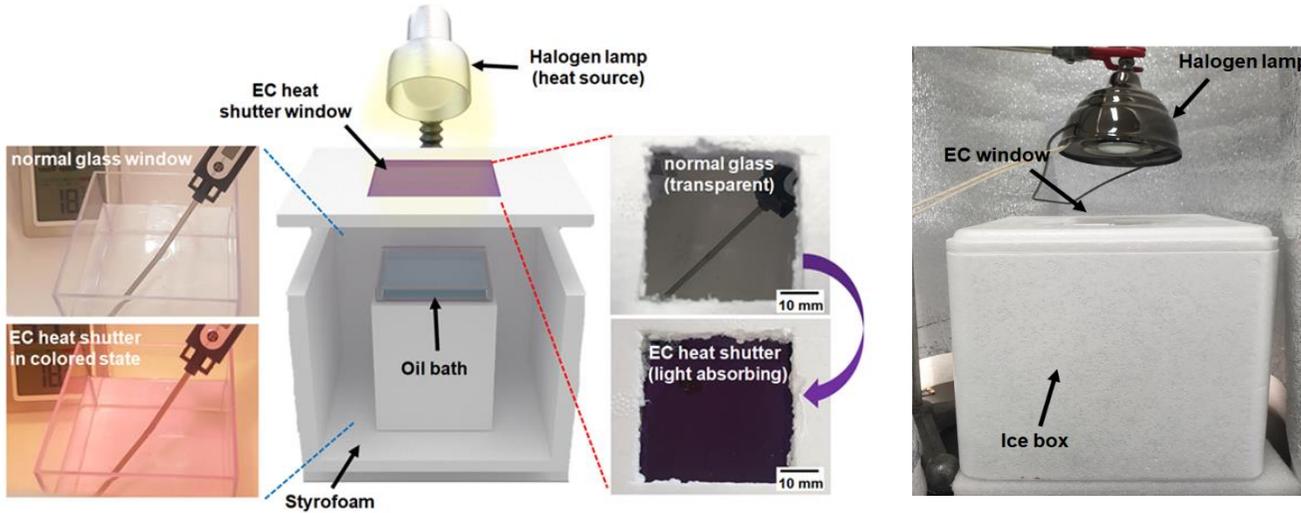
■ 슈퍼 커패시터 최적화 및 특성 측정



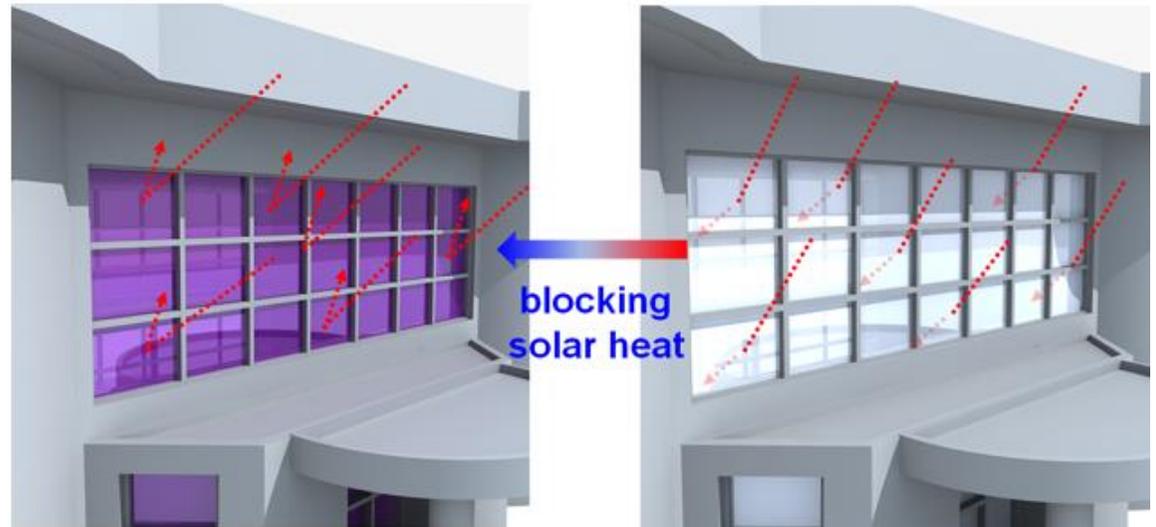
IR 영역의 파장 흡수
→ 태양 에너지 차단 장치로의 활용 가능성

2. 연구내용

■ 효과적인 태양열 차단 장치로의 적용



전기 변색 스마트 윈도우

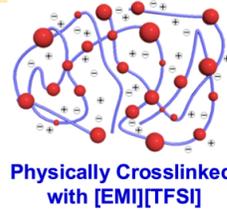


3. 연구성과

2020 추계 고분자 학회 연구 성과 발표

Results

- Facile fabrication of new random copolymer for stretchable ion gel.
- Analysis of gel characterization
 - Ultra stretchable ion gel : large transmittance contrast (~97%), stretchability (~850%), cyclic stability (~500 cycles)
 - Highly stable ion gel (more than 13000 cycles), high GF (gauge factor) (~2.73), non-volatile more than ~10 days
- Demonstration to sensory platform **lonoskin** attached to human body (knees, finger, elbow and ankle)
- Direct Determination of Real-Time human movements



Y. M. Kim, H. C. Moon, *Adv. Funct. Mater.*, 2020, 30 (4), 1907290.

Acknowledgement

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연구 결과 학회 발표 및 수상

- 장기간 사용에도 안정성이 보장된 변색소자 기술 확보 및 산업화 가능성 타진
- 변색소자를 필요로 하는 연구 부문에 적용, 추가 후속연구 진행에 유용.
- 2020년 추계 고분자학회 연구 성과 발표 3건 및 우수 발표상(영어) 수상

Ultra-Low Power Electrochemical Heat Shutters Based on Diffusion-Controlled Electrochromic Behaviors

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School of Chemical Engineering, Yeungnam University
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Introduction & Objective

- Diffusion-controlled electrochromic devices
- Effective Solar Heat Shutter

Results & Discussion

- Synthetic Routes of Mono- and Poly-viologens
- Optical Properties of ECDs
- UV-vis-NIR spectra
- Photographs
- Cyclic Voltammograms
- CELAB Color Coordinates
- CELAS Color Coordinates
- Application to Solar Heat Shutter

Summary

In this study, high molecular weight polymers (poly-viologens) were designed to lower the efficiency of EC absorption and to minimize self-absorbing. In comparison with devices based on mono-viologens corresponding to the monomer of poly-viologens, the advantages of poly-viologens-containing ECDs include lower absorption voltage, lower power consumption to obtain a colored state and higher coloration/bleaching cycle stability. Moreover, the strong absorption of the near-IR region of poly-viologens ECDs was exploited to demonstrate their feasibility as effective heat shutters.

Acknowledgement

This work was supported by Korea National Research Foundation of Science and Technology (NRF) grants funded by the Korean government (MEST, NRF-2017H1D8A1030582). Also, the authors would like to thank the Center for Polymer Research of Yeungnam University for their kind support.

Metal-doped Nickel Oxide Thin Film Electrodes for High Performance Electrochromic Supercapacitors

Department of Chemical Engineering, University of Seoul
Seon Yeong Kim, Tae Yong Yun, Kyeong Su Yu and Hong Chul Moon*

Introduction & Objective

- We fabricated high-performance asymmetric electrochromic supercapacitor (EC-SC) based on WO₃ and NiO thin films.
- Reliable superior EC performances were achieved by (1) tuning the stoichiometric balance between WO₃ and NiO
- (2) Doping Cu into the NiO films was followed to enhance the capacitive and electrochromic properties.

Results & Discussion

- Optimization of NiO film thickness
- Cu doping effect
- Optimization of Cu concentration
- EC properties of Cu-doped-7 ECs
- Device stability of Cu-doped-7 ECs
- Practical feasibility

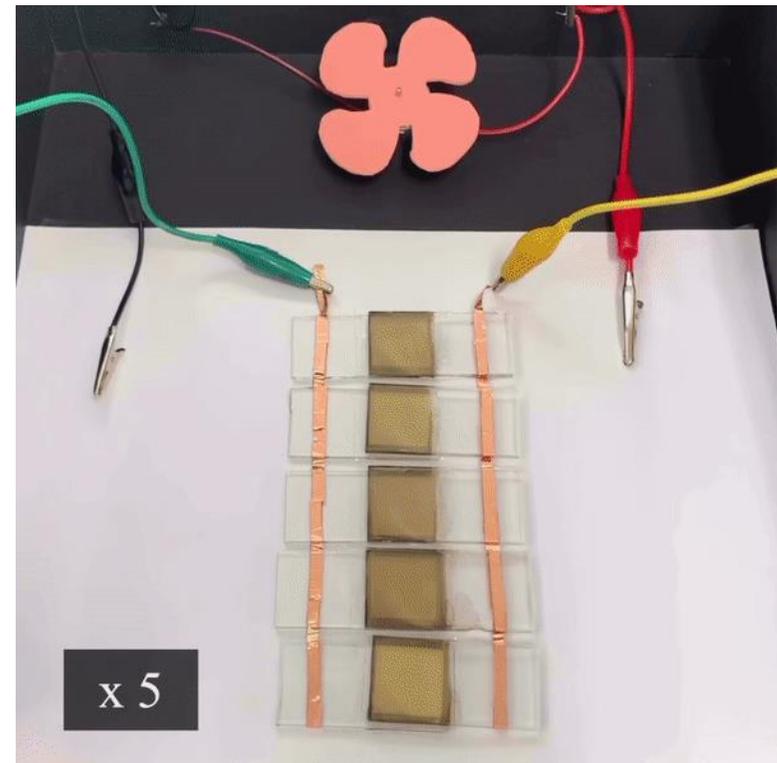
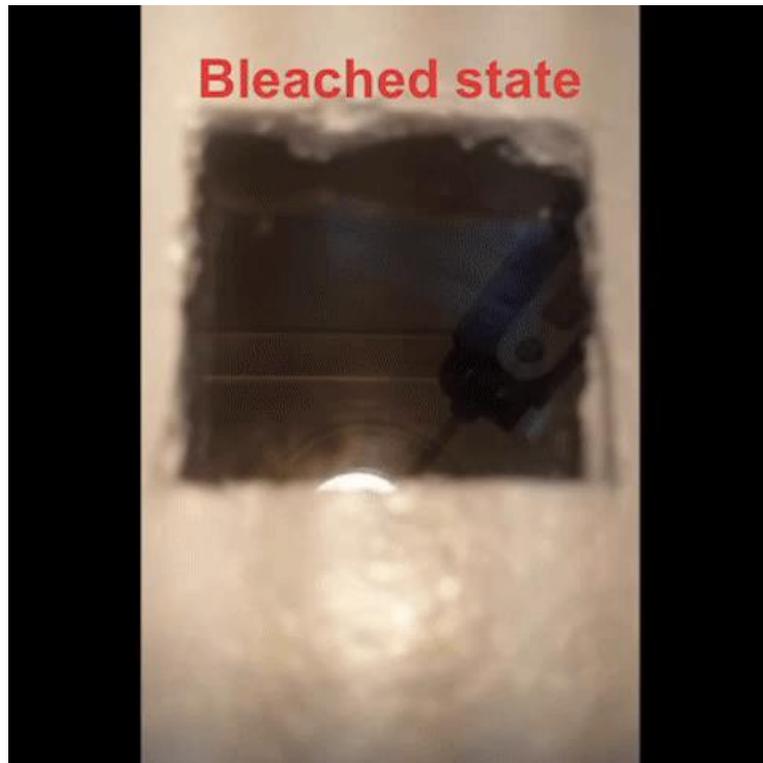
Summary

- An electrochromic supercapacitor (EC-SC) was fabricated, which has a configuration of FTO/Cu-doped NiO/NiO gel electrolyte/WO₃/FTO.
- EC-SC exhibited (a) 1) improvements in energy density (NiO) and (b) enhanced EC performance (NiO).
- Finally, introducing electrochromic and capacitive properties of optimized EC-SC was followed.
- To demonstrate the practical application, the operation of the mini-motor and 24 LEDs was shown.

Acknowledgement

This research was supported by X-mind Corps program of National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT (NRF-2017H1D8A1030582).

4. 결론

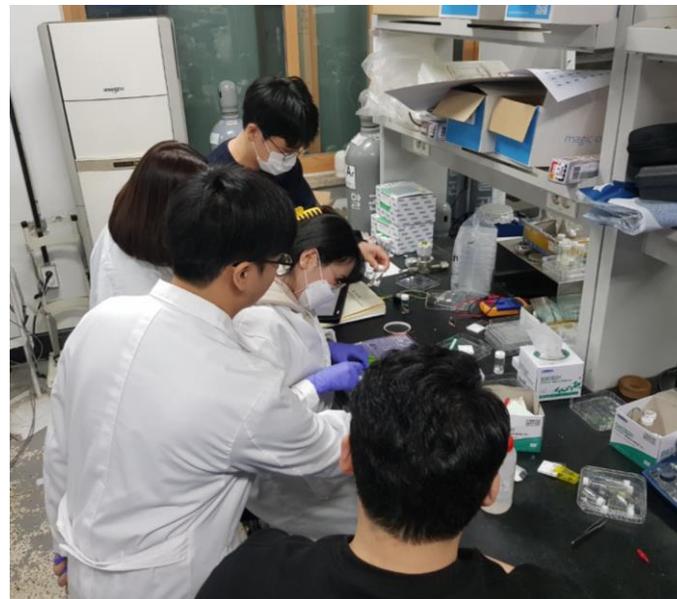


미래형 에너지 저장소자로 사용할 수 있는 이온 젤 기반 슈퍼 커패시터

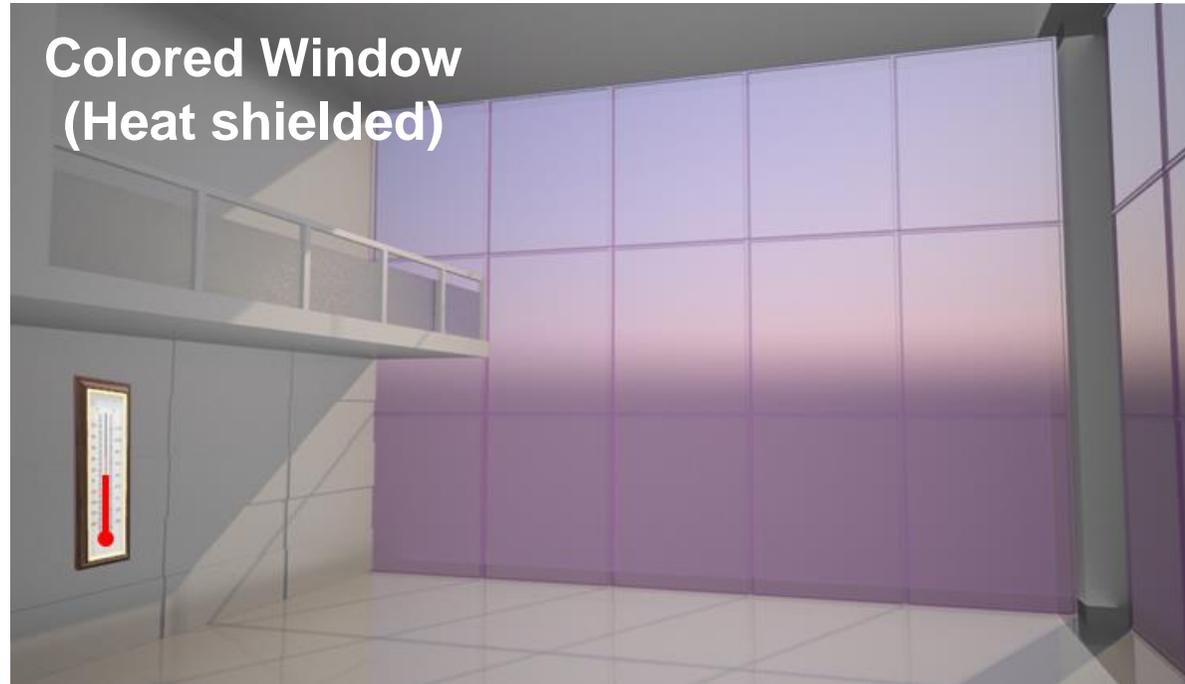
5. 활동 사진



팀 연구 활동



산업체 멘토와의 활동



Energy-saving, Optically esthetic window