| 논문원고접수 |
2018년 12월 3일(월) ~ 12월 31일(월)

| 논문심사결과 통보일 |
2019년 2월 11일(월)까지 홈페이지 (http://www.micronanos.org)에 공지 및 책임저자에게 이메일로 통보

| 초록 및 논문접수처 |
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| 논문범위 |
1. Materials, Fabrication, and Packaging Technologies
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주최 : (사)마이크로나노시스템학회 (E-mail : master@micronanos.org, 전화 : 02-749-6482)

제21회 KMEMS 학술대회 POSTER SESSION

Poster Session 1 (TP-1)

4월 4일 목요일
16:50~ 18:00

논문 No.	발표장소	Journal Title	First Author	Corresponding Author	Presenting Author	Organization
TP-1-01	무궁화룸	Bio-oriented perm-selective structures for micro-nanofluidic applications	박성민	김성재	박성민	서울대학교
TP-1-02	무궁화룸	높은 감도와 극저농도 측정 능력을 가진 가스 센서의 제작을 위한 이황화몰리브덴의 안정적인 기능화 기술	김대기	김준협	김준협	고려대학교
TP-1-03	무궁화룸	웨어러블 응용을 위한 광 투과방식 유연 인장 센서 패키징	구지민	박인규	구지민	한국과학기술원
TP-1-04	무궁화룸	탄소나노튜브와 은나노와이어 복합체 기반 신축 직물 히터	안준성	박인규, 정준호	안준성	한국과학기술원
TP-1-05	무궁화룸	Electrochemical charge storage evaluation of nanostructured manganese sulfide thin film	Rahul B. Pujari	이동원	Rahul B. Pujari	전남대학교
TP-1-06	무궁화룸	프리즘기반의 비접촉 레이저 간섭 리소그래피를 통해 제작한 나노패턴 수치 시뮬레이션 및 AFM 측정	이성재	신보성	이성재	부산대학교
TP-1-07	무궁화룸	Hierarchical구조 기반의 신축성 투명 omniphobic PDMS 필름 제작	유채린	이동원	유채린	전남대학교
TP-1-08	무궁화룸	Dynamics of nanoelectrokinetic preconcentrated DNA leveraged by convection and diffusion	백성호	김성재	백성호	서울대학교
TP-1-09	무궁화룸	전극 위 절연층 에칠 윈도우 위치에 따른 유전영동 트랩 현상 비교	여강인	이상우	여강인	연세대학교
TP-1-10	무궁화룸	Electrode design for pH control in nano-electrokinetic device	오지환	김성재	오지환	서울대학교
TP-1-11	무궁화룸	제브라피쉬 정렬을 위한 유체 교환식 마이크로 유체 채널	이유현	김소희	이유현	대구경북과학기술원
TP-1-12	무궁화룸	확산 영동을 이용한 연속적 나노 입자 분리에서 pH의 효과 Effect of pH on Diffusiophoresis-based Continuous Nanoparticle Separation	서명진	김성재	서명진	서울대학교
TP-1-13	무궁화룸	Patternable particle microarray utilizing sequential particle delivery	이상현	김준원	이상현	포항공과대학교
TP-1-14	무궁화룸	강제적 정상 상태 달성을 통한 이온 선택적 전류에서의 음의 전도도 제거.	권순현	김성재	권순현	서울대학교
TP-1-15	무궁화룸	Spontaneous Selective Preconcentration Leveraged by Convective Flow through Paper-based Micropores over Diffusiophoresis	이도근	김성재	이도근	서울대학교
TP-1-16	무궁화룸	마이크로 표면구조 및 전기전도성에 따른 심근세포의 성숙에 관한 연구	김종윤	이동원	김종윤	전남대학교
TP-1-17	무궁화룸	세포 자극 및 실시간 관찰을 위한 스테이지-탑 바이오리액터의 제작 및 평가	정윤진	이동원	정윤진	전남대학교
TP-1-18	무궁화룸	Microfluidic channel based stretchable pressure sensor for wireless health monitoring	Munirathinam	이동원	Munirathinam	전남대학교
TP-1-19	무궁화룸	Characterization of the membrane capacitance and permeability changes caused by cholesterol depletion based on Dielectrophoretic System	김채원	이상우	김채원	연세대학교 의공학부
TP-1-20	무궁화룸	A PDMS 기반의 유연한 피질뇌파측정용 전극 어레이	이경연	김소희	장재원	DGIST
TP-1-21	로즈룸	Effect of wrinkled metallic thin film in cardiomyocyte growth and maturation	노민	이동원	노민	Chonnam National University
TP-1-22	로즈룸	고정된 PCR Assay를 이용한 와파린 약물 관련 SNP 검출	배서진	김상효	배서진	가천대학교
TP-1-23	로즈룸	폴리머 기반의 유연한 3 차원 전극의 장기간 사용적합성 평가	장재원	김소희	장재원	DGIST
TP-1-24	로즈룸	Novel silicon cantilever integrated with surface-patterned polymer thin layer and strain sensor for biomedical applications	Mingming Dong	이동원	동밍밍	Chonnam National University

TP-1-25	로즈룸	생체 조직의 임피던스 측정을 위한 SU-8/CNT 복합 고분자 마이크로프로브 제작	양다솜	류원형	양다솜	연세대학교
TP-1-26	로즈룸	마이크로 스케일 표면구조에서의 액토미오신 수축과 미세소관 기반 물질 전달에 의한 세포의 정렬 및 이동	서수민	Chin-Lin Guo, 이원희	서수민	한국과학기술원
TP-1-27	로즈룸	Epitaxial Silicon Nano-Wire Arrays for Sensor Applications 센서응용을 위한 에피 실리콘 나노와이어 어레이	장현익	박재홍	박재홍	나노종합기술원
TP-1-28	로즈룸	Fabrication and Measurement of Optical Waveguide Sensor Based on Localized Surface Plasmon Resonance (국소화 표면 플라즈몬 공명 기반 광도파로 센서의 제	김형민	이승기	김형민	단국대학교
TP-1-29	로즈룸	Flexible Pressure Sensor Based on Porous Elastomer Containing Conductive Filler for Tactile Applications	최중락	박인규	최중락	한국과학기술원
TP-1-30	로즈룸	결정립 구조 조절을 통한 CuO 가시광 포토디텍터의 성능 향상에 관한 연구	송현주	윤준보	송현주	한국과학기술원
TP-1-31	로즈룸	질화 알루미늄을 기반으로 한 미세 압전 트랜스듀서의 제작	여홍구	최홍수	여홍구	DGIST
TP-1-32	로즈룸	무반사 구조를 형성하여 신호대잡음비를 증가시킨 국소화 표면 플라즈몬 공명 기반 광섬유 센서의 굴절률 측정	배세웅	이승기	배세웅	단국대학교
TP-1-33	로즈룸	병렬 V-그루브를 갖는 SU-8 기반의 크랙 센서 제작 및 응용	박종성	이동원	박종성	전남대학교
TP-1-34	로즈룸	355 nm 나노초 펄스 레이저를 이용해 제작한 폴리이미드/PDMS 샌드위치 구조를 가지는 유연하고 우수한 민감도의 압력센서	정성엽	신보성	정성엽	부산대학교
TP-1-35	로즈룸	FTIR을 이용한 초박형 카메라 기반 지문 영상 획득 장치	장경원	정기훈	장경원	한국과학기술원
TP-1-36	로즈룸	Fabrication of Thin Film Type Flexible Pressure Sensor Through Microstructuring of Polyimide Film	정용록	박인규	정용록	한국과학기술원
TP-1-37	동백룸	Cell polarization lag with fast input frequency shift in microfluidic dielectrophoresis system	임종원	이상우	임종원	연세대학교
TP-1-38	동백룸	마이크로 추력기 성능 평가를 위한 MEMS 추력 측정 시스템 제작	류영석	이종광	이종광	국립한밭대학교
TP-1-39	동백룸	플라즈모닉 금속 나노입자에 의해 강화된 집적 광촉배식 가스센서	조인철	박인규	조인철	한국과학기술원
TP-1-40	동백룸	팔라듐 나노 아일랜드 구조 기반 수소 스위치	김태환	박인규	김태환	한국과학기술원
TP-1-41	동백룸	고해상도 원거리 이미징을 위한 광 흡수 다중 층을 갖는 초박형 곤충눈 카메라	김기수	정기훈	김기수	한국과학기술원
TP-1-42	동백룸	고해상도 3차원 이미징을 위한 MEMS 미러 기반 가변구조조명 모듈	서영현	정기훈	서영현	한국과학기술원
TP-1-43	동백룸	위상 천이기를 이용한 가변 주파수 대역 및 해상도를 갖는 주파수 식별기	심성민	김정무	심성민	전북대학교
TP-1-44	동백룸	Bendable Coaxial-shaped Micro-supercapacitor based on Cobalt Hydroxide Nanoflakes for Energy Storage	Swati J Patil	이동원	Swati J Patil	전남대학교
TP-1-45	동백룸	TiO2 층이 삽입된 자연모사 PDMS 구조물 제작 및 광학적 응용	강성민	강성민	강성민	충남대학교
TP-1-46	동백룸	고온발수 구조를 지니는 초소수성 표면 제작	최지성	강성민	최지성	충남대학교
TP-1-47	동백룸	열전소자를 이용한 해상 부유식 태양광 광전 에너지 하베스팅 시스템 개발	김성훈	고정상	김성훈	부산대학교
TP-1-48	동백룸	폴리머 기판 종류에 따른 압전 박막 트랜스듀서 제작	연아라	최홍수	연아라	대구경북과학기술원
TP-1-49	동백룸	높은 변형율을 가지는 실버나노와이어-탄소나노튜브 복합체 기반의 스트레인센서 Strain Sensor Based on Silver nanowire-Carbon Nanotube composite with high	김재건	정대웅	김재건	한국생산기술연구원, 경북대학교
TP-1-50	동백룸	종이기반 마이크로유체 전기화학 연료전지 전력량 향상을 위한 연구 Research for improving the power of paper-based microfluidic electrochemical fuel cell	이천호	안유민	이천호	한양대학교
TP-1-51	동백룸	Reversible Nano Lithography Technology for Commercial Approaches	장현익	박재홍	박재홍	나노종합기술원
TP-1-52	동백룸	가속도 응답 계측을 이용한 딥러닝 기반 구조 건전도 모니터링	WITHDTAWN			

Bendable Coaxial-shaped Micro-supercapacitor based on Cobalt Hydroxide Nanoflakes for Energy Storage

[1]Swati J Patil, [1]Rahul Pujari, [1]Jongsung Park, [1,2]Dong-Weon Lee*

[1]MEMS and Nanotechnology Laboratory, Graduate School of Mechanical Engineering,
[2]Center for Next-Generation Sensor Research and Development,
Chonnam National University, 300 Youngbong, Buk, Gwangju 500-757,
Republic of Korea.
E-mail: mems@jnu.ac.kr

에너지 저장을 위한 코발트 수산화물 나노 플레이크 기반의 유연 수퍼커패시터

[1]Swati J Patil, [1]Rahul Pujari, [1] 박종성, [1,2] 이동원*,
[1] 전남대학교 기계공학부, [1,2] 전남대학교 차세대센서연구개발센터

Abstract

In this work, micro-supercapacitor is proposed as energy storage based on bendable co-axial shaped Cu-wire and metal oxide nanomaterial. Firstly, the cobalt hydroxide nanoflakes were grown on Coaxial-shaped Cu-wire by the electrodeposition method at room temperature. Further, the micrographs of the coated material were visualized by electron scanning microscopy technique. Nanoflakes coated Cu-wire with flakes width is in nanometer exhibits the porous surface microstructure. The electrochemical studies demonstrated that, Cu/$Co(OH)_2$ nanoflakes electrode shows the highest areal and specific capacitance with their values of 5.46 mF and 55 F g^{-1}, respectively.

Keywords: ***Micro-supercapacitor, Cu-wire, Nanoflakes, Capacitance***

1. Introduction

Power-saving systems have become one of the most critical subjects in learning to deal with current energy challenges and rapid development of enabled gadgets in portable and wearable electronic devices [1]. Amongst them, micro-supercapacitor is a multifunction energy storage device becomes in research progress to look for small substances and integrated into smaller shape and size. Micro-supercapacitor is shown in the strongest state to be utilized due to the high power density, large storage capacity, good cyclic stability, and intrinsic safety [2]. In a sequence of electrical utilization in such a way has been efficiently and successfully increased the duration of its use, it is necessary to have portable energy storage devices in wire form which can be adapted to those used for energy conversion [3]. For supercapacitors, a number of electroactive materials were employed [4-6]. Out of these metal oxide based pseudocapacitive material are most popular to have excellent charge storage capacity [7]. The cobalt-based Co (OH) 2 is regarded as a hopeful electrode material due to its layered structure having a large interlayer spacing [8].

In this work, micro-electrode was prepared on Coaxial-shaped Cu-wire and then coated with cobalt-hydroxide nanoflakes. Further, surface morphology studies were analyzed. The electrochemical characterizations in terms of cyclic voltammetry and impedance analysis were carried out by the electrochemical workstation.

2. Experimental details

Fig. 1 displays the schematic diagram of the fabrication process of Cu/$Co(OH)_2$ nanoflakes micro-supercapacitor. The Cu-wire was used as backbone support and then $Co(OH)_2$ nanoflakes grown on that by electrodeposition method. The electrolyte was prepared by dissolving the appropriate amount of $Co(NO)_3.6H_2O$ in distilled water. A constant current of -1 mA Vs saturated calomel electrode (SCE) electrode applied for 120 s. After deposition, the micro-electrode rinsed in distilled water, dried and used for further measurements.

3. Results and discussion

The surface microstructure of the electrodeposited material was characterized by field emission scanning electron microscopy. The typical surface micrographs of the nanolayer coated electrode are seen in Fig. 2 (a, b). The electrode consists of porous $Co(OH)_2$ nanoflakes surface with flake width in the range of ~10 nm. The porous surface morphology of the $Co(OH)_2$ electrode beneficial for the fast ion diffusion in the electrolyte. Further, the conventional three-electrode mode was employed for electrochemical analyses using Cu/$Co(OH)_2$ nanoflakes, platinum foil and SCE as an active, counter and reference electrodes, respectively. The experiment was performed with 1 M KOH electrolyte at room temperature using an Ivium electrochemical workstation. The capacitance of the Cu/$Co(OH)_2$ nanoflakes was calculated according to the following equation,

$$C_a = \frac{\int I(V)dV}{A \cdot \nu \cdot \Delta V} \qquad (1)$$

Where, Ca is the areal capacitance of the electrode material. $\int I(V)dV$ and A is the area under the CV curve and effective active area of the electrode, respectively. ν and ΔV is the scan rate and potential window.

The electrochemical measurements of Cu/$Co(OH)_2$ nanoflakes electrode are shown in Fig. 3. The cyclic voltammograms of the

$Cu/Co(OH)_2$ nanoflakes electrode at the different scanning rates with 0.5 V voltage window illustrated in Fig. 3(a). Using Eq. (1), the areal capacitances of $Cu/Co(OH)_2$ nanoflakes electrode calculated and plotted in Fig. 3(b) as a function of scan rates. The highest areal capacitance of 5.46 mF was observed at the lower scan rate of 1 mV s^{-1}. Further, the total charge distributions were determined by using the power law [9]. Fig. 3(c, d) demonstrates the capacitive-dominated and diffusion-controlled contribution to the total charge storage on $Cu/Co(OH)_2$ nanoflakes electrode at the lower scanning ranges from 1 to 40 mV s^{-1} conducted in 1 KOH electrolyte solution. It is seen that the nearly 90 %, a capacitive-processes dominated at lower scan rate [10].

Nyquist plot of the $Cu/Co(OH)_2$ nanoflakes electrode represents a near-vertical line intersection with X-axis in the low-middle frequency range as shown in Fig. 4(a). The corresponding the relaxation time constant was calculated ($\tau 0=1/f0$) to be 4 ms at the frequency where the phase angle of 45º (Fig 4(c)). The bode magnitude and phase plot of the $Cu/Co(OH)_2$ nanoflakes electrode are shown in Fig. 4(b, c). The dependence of normalized capacitance with the frequency of $Cu/Co(OH)_2$ nanoflakes electrode was dissipated in Fig. 4(d). From this data, it is clear that at a lower frequency range the $Cu/Co(OH)_2$ nanoflakes electrode shows the good capacitive activities.

4. Conclusion

In conclusion, we have successfully deposited $Co(OH)_2$ nanoflakes on a Cu-wire via an electrodeposition method. The resultant $Cu/Co(OH)_2$ nanoflakes electrode exhibit a high capacitance of 55 F g^{-1} and demonstrated capacitive dominated kinetics. The proposed wire-shaped electrode has great potential to use in power electronics as a micro-electrode.

Acknowledgments

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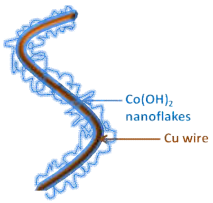

Fig. 1 The schematic illustration shows the bendable micro-electrode fabricated on Cu-wire coated with $Co(OH)_2$ nanoflakes.

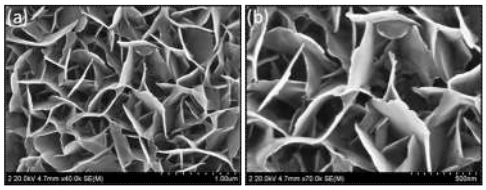

Fig. 2 FE-SEM images of the $Co(OH)_2$ nanoflakes at two magnifications.

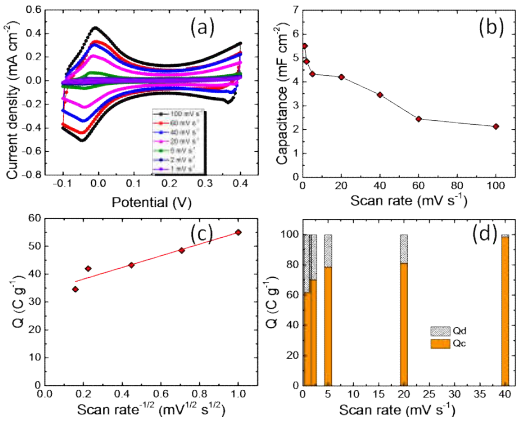

Fig. 3 (a) The electrochemical cyclic voltammograms of the fabricated $Cu/Co(OH)_2$ nanoflakes micro-supercapacitor and corresponding areal capacitances at different scan rates (b). (d) The contribution ratio of diffusion-controlled and capacitive dominated to total charge storage (c) at different scanning rates of the fabricated $Cu/Co(OH)_2$ nanoflakes micro-supercapacitor.

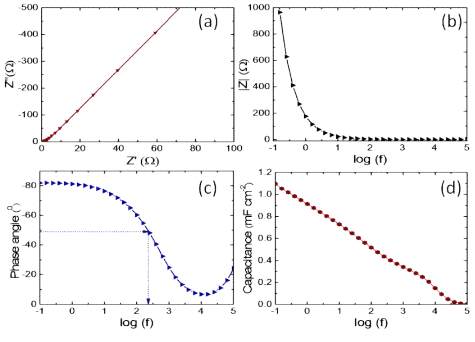

Fig. 4 (a-d) Impedance analyses of the fabricated micro-supercapacitor; (a) Nyquist plot, (b, c) Bode magnitude and phase plot, (d) capacitance against logarithmic frequency.

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BENDABLE COAXIAL-SHAPED MICRO-SUPERCAPACITOR BASED ON COBALT HYDROXIDE NANOFLAKES FOR ENERGY STORAGE

[1]Swati J. Patil[1], [1]Rahul Pujari, [1]Jong Sung Park, and [1, 2]Dong Weon Lee*

[1]MEMS and Nanotechnology Laboratory, School of Mechanical Engineering,
[2]Center for Next-generation Sensor Research and Development, Chonnam National University, Gwangju 61186, REPUBLIC OF KOREA.
S.J. Patil: swatipatil39@gmail.com,*D-W. Lee: mems@jun.ac.kr

ABSTRACT

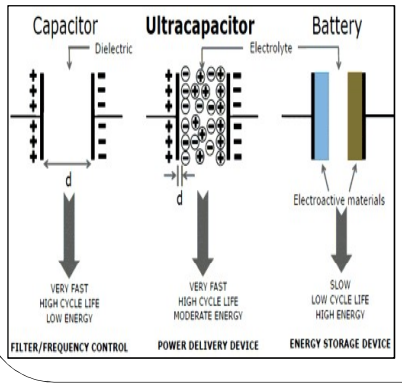
✓**In this work, micro-supercapacitor based on bendable co-axial shaped Cu-wire coated with metal oxide nanomaterial is proposed for energy storage.**

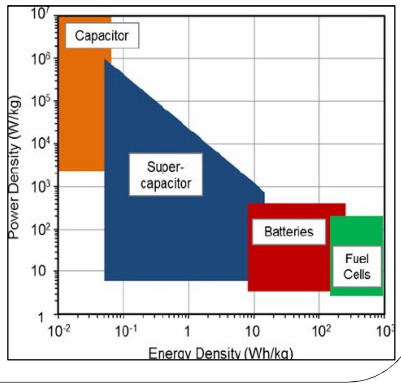
✓**Firstly, the cobalt hydroxide nanoflakes were grown on coaxial-shaped Cu-wire by the electrodeposition method at room temperature.**

✓**Nanoflakes with flakes width is in nanometer exhibits the porous surface microstructure.**

✓**The electrochemical studies demonstrated that, Cu/Co(OH)$_2$ nanoflakes electrode shows the highest areal and specific capacitance of 5.46 mF cm^{-2} and 55 F g^{-1}, respectively.**

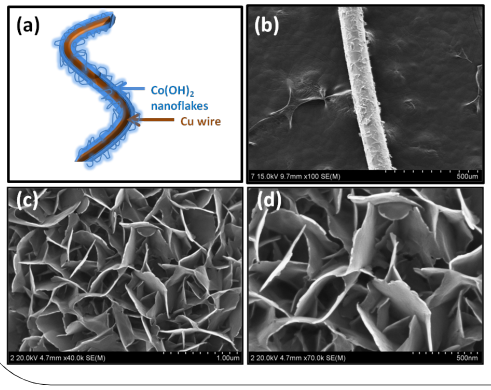
INTRODUCTION OF SUPERCAPACITOR





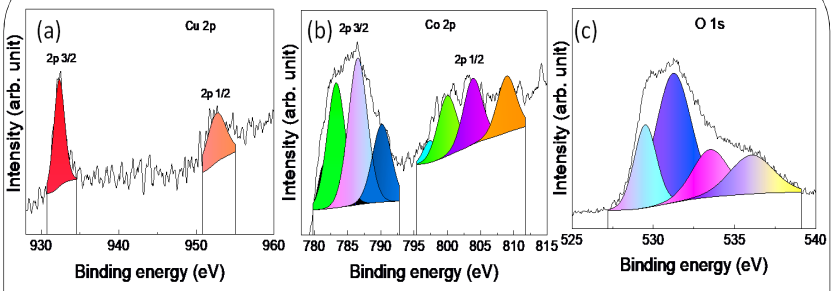
RESULTS AND DISCUSSIONS

MORPHOLOGICAL STUDIES



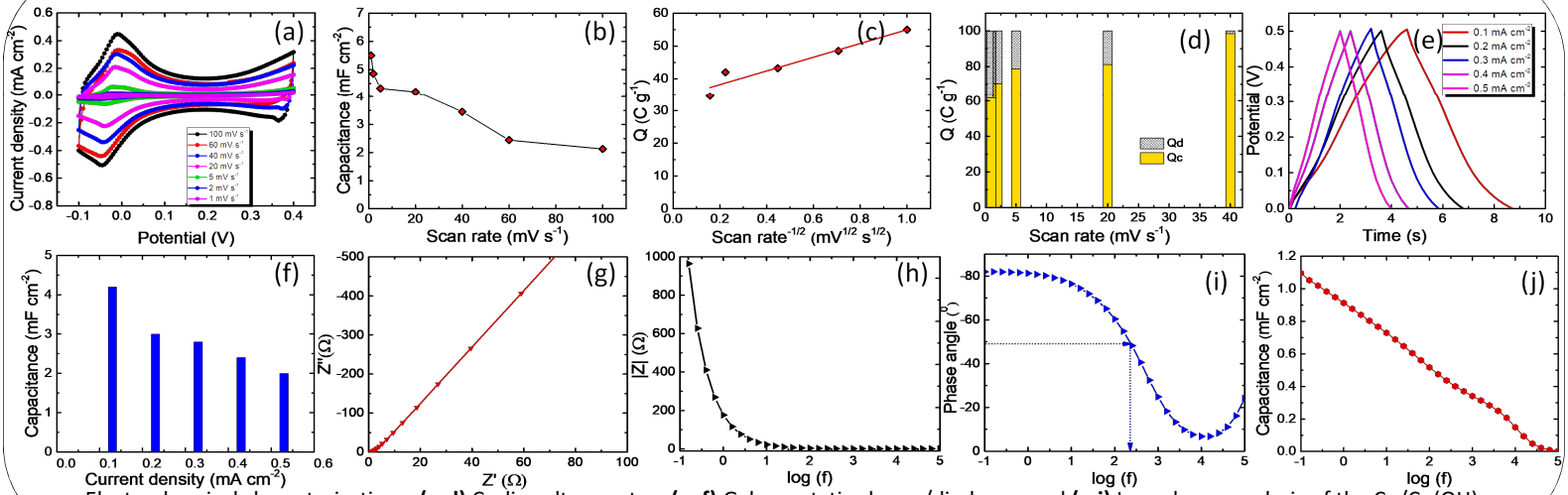
(a, b) The schematic and actual micrographic image (500 µm) of the electrode. FE-SEM images of the Co(OH)$_2$ nanoflakes at **(c)** 1 µm and **(d)** 500 nm magnifications.

STRUCTURAL STUDIES



XPS narrow scan spectra of Cu/Co(OH)$_2$ shows the core-level spectrum of **(a)** Cu 2p, **(b)** Co 2p, and **(c)** O 1s states.

ELECTROCHEMICAL STUDIES



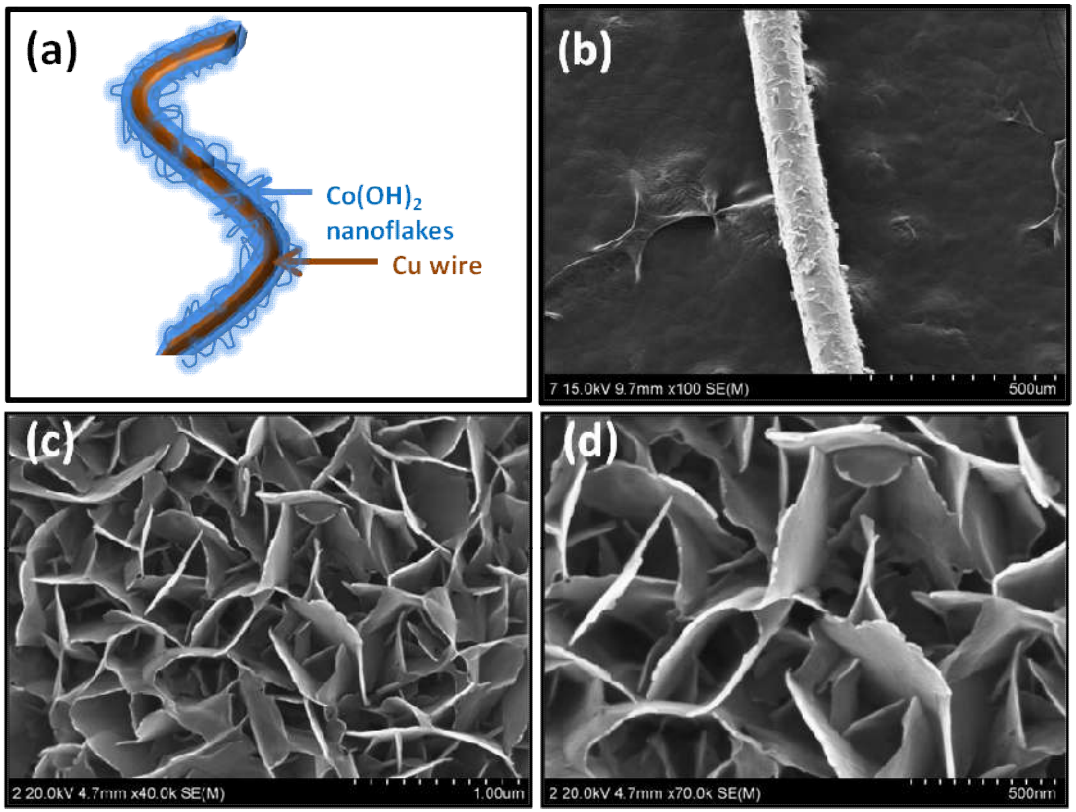
Electrochemical characterizations: **(a-d)** Cyclic voltammetry, **(e, f)** Galvanostatic charge/discharge and **(g-j)** Impedance analysis of the Cu/Co(OH)$_2$ nanoflake electrode material at different scanning rates.

CONCLUSIONS

✓We have successfully deposited Co(OH)$_2$ nanoflakes on a Cu-wire via an electrodeposition method at room temperature.
✓The electrochemical characterizations were systematically studies using cyclic voltammetry, galvanostatic charge/discharge, and Impedance analyses.
✓The resultant Cu/Co(OH)$_2$ nanoflakes electrode exhibit a high capacitance of 5.46 mF cm^{-2} and demonstrated capacitive dominated kinetics.
✓The proposed wire-shaped electrode has great potential to use in power electronics as a micro-electrode.

ACKNOWLEDGEMENT This study was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No.2017R1E1A1A01074550) and Chonnam National University (Grant no. 2017-2837).

MORPHOLOGICAL STUDIES



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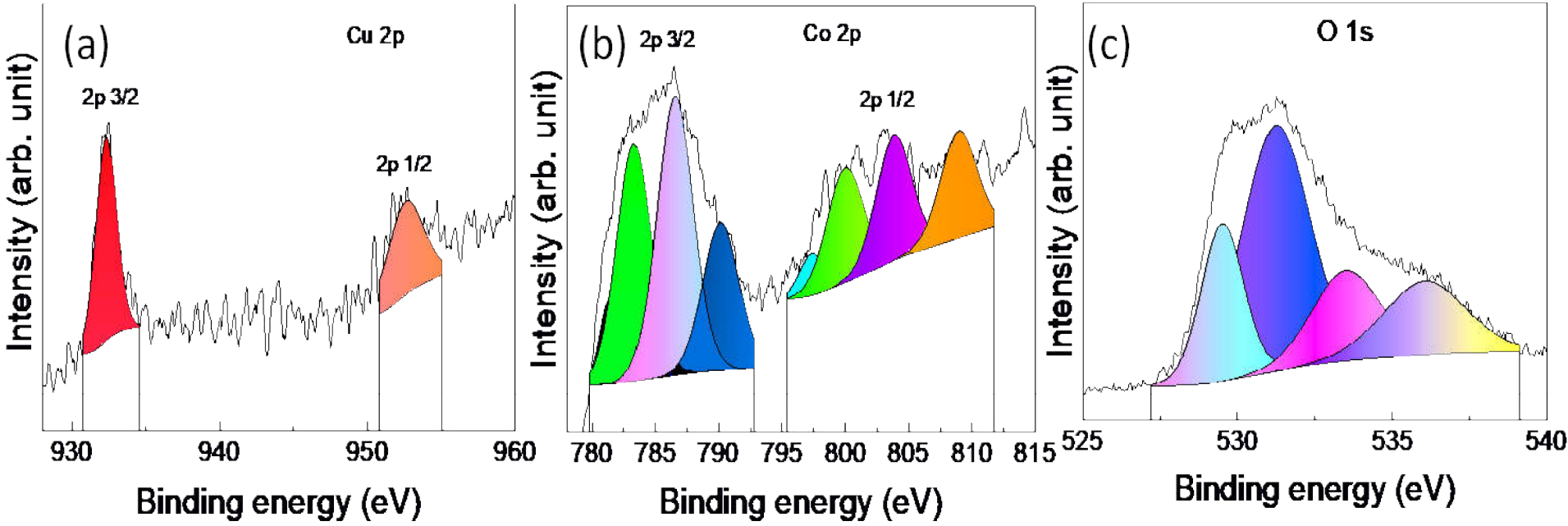
STRUCTURAL STUDIES



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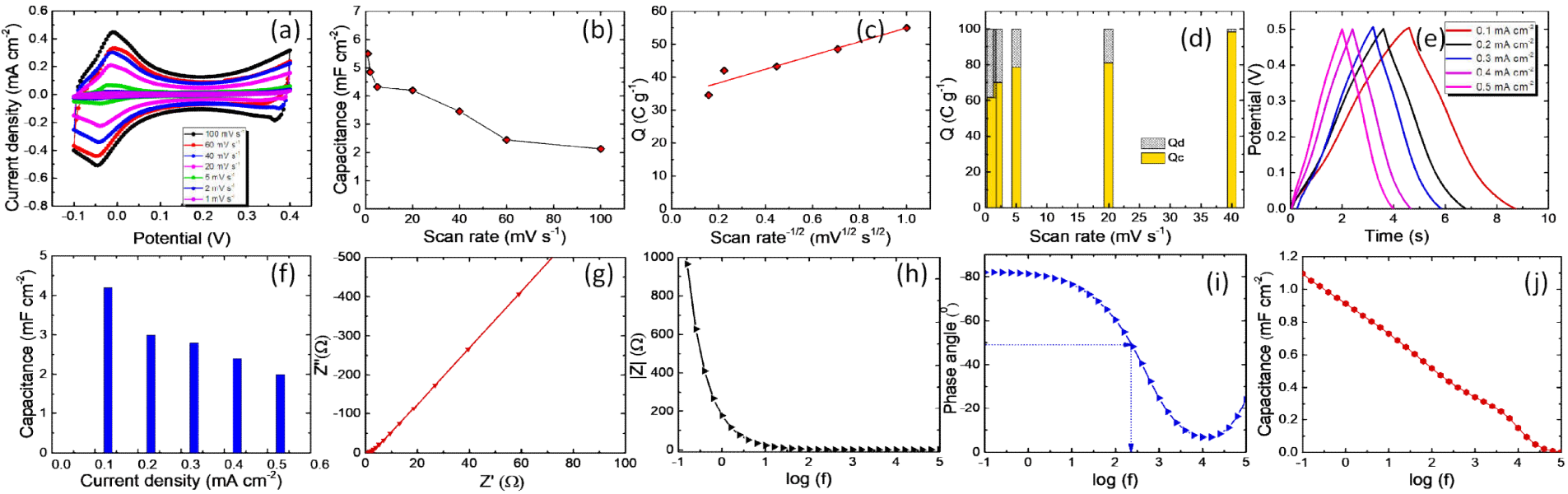

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