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| 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
2. Fundamentals in MEMS/NEMS
3. Micro/Nanofluidics and Lab-on-a-Chip
4. Bio/Medical Micro/Nano Devices
5. Micro/Nano Sensors and Actuators
6. RF/Optical Micro/Nano Devices
7. Micro/Nano Energy Devices
8. Flexible and Printed Devices
9. MEMS/NEMS Applications and Commercialization

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Poster Session 2 (FP-2)

4월 5일 금요일
10:50 ~ 12:00

논문 No.	발표장소	Journal Title	First Author	Corresponding Author	Presenting Author	Organization
FP-2-01	무궁화룸	광 강도에 따른 하이드로젤 3차원 구조의 치수에 관한 연구	임종경	김준원	임종경	포항공과대학교
FP-2-02	무궁화룸	Large area nanowire fabrication method by using sacrificial shadow patterning on nanograting	조민승	윤준보	조민승	한국과학기술원
FP-2-03	무궁화룸	Fabrication of Asymmetric Microstrucutres for Capillary Wicking Enhancement	김정환	이충엽	김정환	경희대학교
FP-2-04	무궁화룸	Optically transparent and flexible super-hydrophobic film based on siloxane functionalized UV curable polyurethane-acrylate	Bui Quoc Huy Nguyen	이동원	아룬	Chonnam National University
FP-2-05	무궁화룸	Optically Transparent Superhydrophobic Thin Film Based on PUA/GO Hybrid Composite Materials	후천봉	이동원	후천봉	Chonnam National University
FP-2-06	무궁화룸	Nanotransfer printing on fabric using water-soluble polymer and its application to hydrogen sensor	고지우	박인규	고지우	한국과학기술원
FP-2-07	무궁화룸	내화학성 박막 폴리머 미세유체 반응기 Chemically inert, thin-film polymer microfluidic reactor	정범준	이원희	정범준	한국과학기술원
FP-2-08	무궁화룸	Asymmetric transition of electroconvective instability on water-permeable ion-selective surface	최지혜	김성재	최지혜	서울대학교
FP-2-09	무궁화룸	Microfluidic Synthesis of Polymeric Vesicles via Flow-Induced Self-Assembly of Polystyrene-block-poly(ethylene glycol)	Xuan Don Nguyen	고정상	Xuan Don Nguyen	부산대학교
FP-2-10	무궁화룸	Fabrication of Peristaltic Micro Pump and Its Dynamic Characteristics	장준호	정옥찬	장준호	인제대학교
FP-2-11	무궁화룸	Fabrication of Pneumatic Two-way Valve with Curved Fluid Chamber	김병우	정옥찬	김병우	인제대학교
FP-2-12	무궁화룸	Elimination of toxicity components for nanoelectrokinetic artificial kidney experiments	홍성준	김성재	홍성준	서울대학교
FP-2-13	무궁화룸	높은 처리량의 연속적인 유해균 농축을 위한 자기영동 기반의 미세유체 소자	정택언	양성	정택언	광주과학기술원
FP-2-14	무궁화룸	Enzyme based membraneless microfluidic biosensor for glucose monitoring	칸하룬	김규만	칸하룬	경북대학교
FP-2-15	무궁화룸	단일 세포 분석을 위한 EWOD 칩에서의 nL-스케일 액적 조작에 관한 연구	김한별	양성	김한별	광주과학기술원
FP-2-16	무궁화룸	Design, fabrication, and verification of rapid kit cartridges for undiluted whole blood applications	최요한	최요한	최요한	한국전자통신연구원
FP-2-17	무궁화룸	Streptavidin Agarose Resin을 이용한 종이기반의 ELISA 성능 향상 연구	김혜린	이정훈	김혜린	광운대학교
FP-2-18	무궁화룸	정전분무 고폭비 마이크로 노즐을 이용한 미생물 살균 기능의 물 미세 액적 생성	정지훈	이승섭	정지훈	한국과학기술원
FP-2-19	무궁화룸	The Observation of Cellular Dielectrophoretic Behavior above a few MHz	이상현	이상우	이상현	연세대학교
FP-2-20	무궁화룸	LOCOS 공정을 이용한 단일 실리콘 나노와이어 전계효과 트랜지스터 제작 연구 Fabrication of Single Silicon Nanowire Field-Effect Transistor (FET) Using the LOCal Oxidation of Silicon (LOCOS)	김정아	유성근	김정아	오송첨단의료산업진흥재단
FP-2-21	로즈룸	Constant Phase Element의 변화량과 적혈구 변형능과의 연관성	손민국	양성	손민국	광주과학기술원
FP-2-22	로즈룸	땀의 장기적 모니터링을 위한 오픈 채널형 Sweat VIA (Open channel Sweat VIA for long-term monitoring of sweat rate)	최진아	곽노균	최진아	한양대학교
FP-2-23	로즈룸	Biconcave 형태의 적혈구를 사용한 유전율 스펙트럼 실험결과의 수치 분석	Zhbanov Alexander	양성	Zhbanov Alexander	광주과학기술원
FP-2-24	로즈룸	프로히비틴 2의 전기화학적 고감도 검출을 위한 항체 고정화 비교 연구 (A comparative study into the antibody immobilization for the sensitive electrochemical detection of prohibitin 2)	윤영란	양성	윤영란	광주과학기술원
FP-2-25	로즈룸	Application of Magnetic Bead Based Nano-gap Sensor for diagnosis Non-Small Cell Lung Cancer	이수현	이수현	이수현	한국과학기술연구원

Optically Transparent Superhydrophobic Thin Film Based on PUA/GO Hybrid Composite Materials

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PUA / GO 복합 재료를 기반으로 하는 투명한 초발수성 필름

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Abstract

Herein, we present a facile fabrication method to prepare the optically transparent, flexible and self-cleanable poly(urethane acrylate) (PUA) superhydrophobic film. The low surface energy siloxane functionalization on the thermally activated μ-patterned PUA/graphene oxide composite (S-PG) was found to be a successful strategy to modify the PUA intrinsic hydrophilicity into superhydrophobic nature. The S-PG film repeatedly showed the water contact angle (WCA) of 150.3 ± 1.6° with excellent self-cleaning property. Further, the fabricated film exhibited high optical transparency (82%) in the 400-800 nm wavelength region. Finally, the practical applicability of the fabricated S-PG film was demonstrated by using the film as a protective layer for solar panel module. The power conversion efficiency (PCE) of the solar module with and without S-PG superhydrophobic film was found to be 5.98% and 5.82%. The enhancement in the PEC performance of the solar module is attributed to the excellent optical transparent and less light reflecting nature of the proposed film.

Keywords: ***Siloxane functionalization, PUA, polydimethylsiloxane (PDMS) chemical vapor deposition (CVD)***

1. Introduction

A surface that exhibits a WCA more than 150º with a sliding angle (SA) less than 10º is commonly called superhydrophobic surface [1]. Such surface is always self-cleaned by the enrolling water droplet and received significant attention in several applications, such as anti-fouling, self-cleaning, anti-friction, oil/water separation. The optically transparent superhydrophobic film has been used as a protective layer in numerous electronic devices, solar cell panels, safety goggles, construction, stain-resistant textiles, microfluidics, biomedical devices, energy harvesting, aerospace, marine and automobiles industries [2]. Several years of research on superhydrophobic film have provided key understanding on the control parameters and material tailoring techniques. Among them, efforts have demonstrated that a combination of microscale roughness in synthetic materials together with low surface energy could greatly improve the superhydrophobic nature of the material. Over the years, several polymers based superhydrophobic films have been reported by employing those above-mentioned techniques. Though PUA has several excellent characteristics such as good biocompatibility, high transparency, high deformability and excellent impact strength, there is no report on the PUA based superhydrophobic film owing to its intrinsic hydrophilicity.

Herein, we demonstrate in detail our successful attempt to fabricate the PUA based superhydrophobic film by employing the microarchitectures and surface modification with low surface energy siloxane. Graphene oxide (GO) was incorporated into PUA to improve the chemical bonding between the PUA and siloxane. The fabricated film was characterized in detail by FESEM, EDS, FTIR, Raman, XPS and UVDRS analysis for its morphological, chemical and optical properties. The obtained results are consistent and confirmed the successful formation of the siloxane functionalized PUA+GO (S-PG) superhydrophobic film. Finally, the fabricated film was used as a protection layer for the solar module to demonstrate the practical applicability of the fabricated film.

2. Materials and Methods

2.1 Fabrication of the μ-patterned PUA Film

The PUA+GO (PG) hybrid composite μ-patterned was fabricated by the photolithography technique. In a typical fabrication process, calculated amount of PG was poured into the negative PDMS mold. Then, a flexible and transparent poly (ethylene terephthalate) (PET) supporting film was attached to the PUA. Next, a uniform PUA film was formed on the PDMS mold by mild rolling a roller on top surface of the PET film. Finally, the PG coated PDMS mold was exposed to UV light for 10 hours. After the UV treatment, the μ-patterned PG film was removed from the PDMS mold.

2.2 Fabrication of siloxane functionalized μ-patterned PUA film

The low surface energy siloxane was functionalized on the thermally activated PG through PDMS CVD. In a typical fabrication process, the prepared μ-patterned PG film was attached to the glassware in an upside-down position and placed above the pre-polymer of PDMS coated Si wafer. The PDMS CVD was performed at 285 ℃ at various time to prepare the siloxane functionalized μ-patterned PG film. After the CVD reaction, the prepared material was ultrasonically cleaned to remove the unbonded layer from the surface of μ-patterned PG.

3. Results and Discussion

Morphology of the fabricated S-PG superhydrophobic film was observed by the field emission scanning electron microscope (FESEM). As shown in Fig. 1, the low magnified image shows the microscale roughness of the fabricated film. The dimension of the fabricated film was 20 μm in diameter, 20 μm in height and 70 μm in pillar space, respectively. Further, the materials were characterized in detail by different techniques and the obtained results confirm the successful formation of the siloxane functionalized μ-patterned PUA film.

As shown in Fig. 2, the WCAs of the S-PG films increased with increasing the pillar distance and reached maximum for 100 μm and then decreased. The WCA of the S-PG at 100 μm is found to be 150.3 ± 1.6°. To demonstrate the practical applicability of the proposed transparent superhydrophobic film, the film was used as a protective layer for the home-made solar cell module. The photovoltaic performance of a solar cell module with and without the protection layer was evaluated. As shown in Fig. 3 and Table 1, the S-PG superhydrophobic film protected solar module showed improved power conversion efficiency (PCE) compared to that of bare solar cell module. The enhanced performance of the SP-G-protected solar cell module is attributed to the high optical transparency and less light reflecting nature of the proposed film.

4. Conclusions

In conclusions, we have fabricated optically transparent, flexible and self-cleanable PUA superhydrophobic film by siloxane functionalization through PDMS CVD. It showed high WCA of 150.3 ± 1.6° and high transmittance of 82% in the 400-800 nm wavelength region. And it can be applied as protection layer for the home-made solar cell module.

Acknowledgments

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References

1. Y. Y. Quan, L. Z. Zhang, R. H. Qi, R. R. Cai, Self-cleaning of Surfaces: the Role of Surface Wettability and Dust Types. Sci. Rep. 6, 38239 (Dec. 2016).
2. B. Sahoo, K. Yoon, J. Seo, T. Lee, Chemical and Physical Pathways for Fabricating Flexible Superamphiphobic Surfaces with High Transparency. Coat. 8, 47 (Jan. 2018).

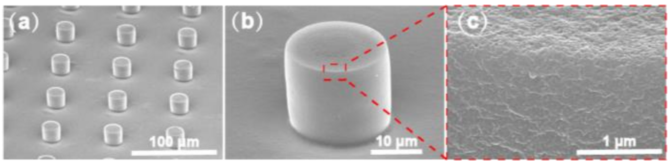

Fig. 1 Field emission scanning electron microscope (FESEM) images of the siloxane functionalized μ-patterned PUA+GO (S-PG) hybrid superhydrophobic film at three different magnifications.

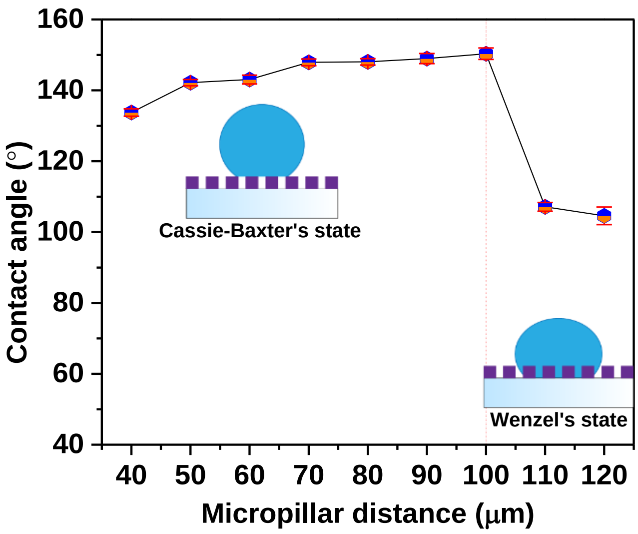

Fig. 2 The WCA of the siloxane functionalized μ-patterned PG (S-PG) films as a function of μ-pillar distance.

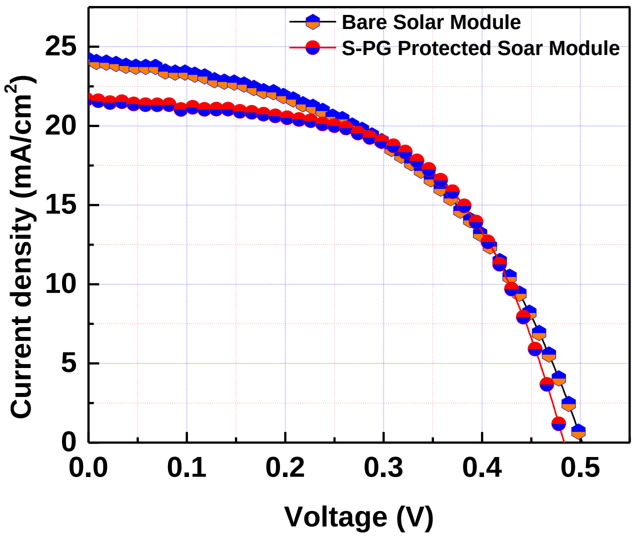

Fig. 3. J–V characteristics of the solar cell module with and without S-PG superhydrophobic film.

Table 1. Photovoltaic characteristics of the solar cell module covered with and without fabricated S-PG superhydrophobic film.

Solar cell module	J_{sc} (mA.cm^{-2})	V_{oc} (V)	FF	PCE (%)
Bare	24.15	0.50	0.48	5.82
S-PG protected	21.56	0.48	0.57	5.98