exchange membranes by direct sulfonation
현승미, 정경석, 황택성*, 충남대학교; *충남대학교 화학공학과

3PS-26 Preperation and characterization of polyphenylene containing hexaphenyl moiety for proton exchange membrane fuel cells
홍태훈, 이순호, 유지호, 담비, 진레이, 김환기, 건국대학교

3PS-27 Synthesis of Low Bandgap, Conjugated Polymers Based on Diketopyrrolopyrrole and Benzothiadiazole
황대현, 안태흥, 권순재, 권용구, 인하대학교

3PS-28 초경량 방탄소재 적용을 위한 열경화성 수지 특성 연구
황세웅, 이정희, 강혜란, 이동진, 박남규*, 한국신발피혁연구원; *대산플랜트

3PS-29 Gas-phase polymerized buffer layer for flexible moisutre barrier by i-CVD
황조은, 이준영, 석지후, 성균관대학교

기능성 고분자(III)

3PS-30 Development of siloxane-based UV curable resins for roll-to-roll UV nanoimprint lithography for 100 nm pitch wire grid polarizer
이영철, 배은진, 강영훈, 조상욱*, 정명영*, 조성윤, 한국화학연구원; *부산대학교

3PS-31 Polyimide/Amine Functionalized Graphene Hybrids for Potential Moisture Barrier Films
이우항, 최면전, 정극민, 하창식, 부산대학교

3PS-32 Synthesis and characterization BINAP based photo-switchable chiral dopant
이은옥, 가재원, 김윤호, 김진수, 장광석, 한국화학연구원

3PS-33 Characterization of water soluble polymeric materials for solar cell
이자민, 남궁한솔, 김충기, 조성진, 권태우, 박동규, 경성대학교

3PS-34 High-strain electroactive polymer actuators by the formation of large concentration gradient
이장우, 권태훈, 홍순만, 구종민, 한국과학기술연구원

3PS-35 Systematic Control Electromagnetic Polymer Micro Rod
이재용, 전금혜, 김진곤, 포항공과대학교

3PS-36 Electrochemical performance of solid polymer electrolyte based on Poly(alkylene carbonate)
이정민, 조남주, 김지승, 부산대학교

3PS-37 Complexation of Self-Assembled Dendron-Cyclodextrin Nanotubes with Polyethyleneimine for Gene Delivery
이정훈, 민두홍, 오은택, 박현주, 김철희, 인하대학교

3PS-38 Extremely Bright AC Driven Polymer Electroluminescence Device Using Solution-Processable Hole-Generation Layer
이주한, 박철민, 김의혁, 연세대학교 신소재공학과 대학원

3PS-39 Preparation of anti-corrosion resin with waterborne polyurethane and polyethylene-*graft*-acrylic acid
이지원, 김시영, 조남주, 부산대학교

3PS-40 Fabrication of Simple Liquid Lens Control System Based on Dielectric Elastomer Actuator
이지현, 이기쁨, 김연주, 나창운, BK21 Plus Haptic Polymer Composite Research Team, Department of Polymer-Nano Science and Technology, Chonbuk National University

3PS-41 Direct Exfoliation of Graphene Using Poly(styrenesulfonic acid graft aniline) as a Surfactant and Its Application to Supercapacitor Electrode
이진우, 조원호, 서울대학교

3PS-42 Fabrication of energy saving film with anti smudge property
이찬형, 함동석, 조성근, 김다혜, 최우진, 김광제, 이상진, 김대수*, 이재흥, 한국화학연구원; *충북대학교

3PS-43 Low Temperature Fabrication of TiO_2 Electrodes for Highly Efficient and Stable Flexible DSSCs
이호림, 황대섭*, 조성무**, 서용석, 김동영**, 서울대학교; *연세대학교; **한국과학기술연구원

3PS-44 Preparation of conductive carbon films from iodinated poly(vinyl alcohol) films
이화수, 김영주*, 정영규*, 황인태**, 정찬희**, 최재학, 충남대학교 고분자공학과; *충남대학교 유기소재섬유시스템공학과; **한국원자력연구원 공업환경연구부

3PS-45 Fabrication of electrospun scaffolds by self-bundling approach for neural tissue engineering
임병기, 최우용, 장재형*, 연세대학교 화공생명공학과; *연세대학교

3PS-46 Photoconductive behaviors of difluorinated 5,11-bis(triethylsilylethynyl) anthradithiophene
임병택, 정대성, 천광희, 조장환, 하재언, 중앙대학교

3PS-47 Fabrication of Hierarchical Nanowire on Honeycomb Structures for Flexible and Omnidirectional n-ZnO NWs/p-Si Heterostructure Photodetectors
임성동, 하민정, 엄두승, 이영수, 고현협, 울산과학기술대학교

3PS-48 A Facile Route to Polyurethane Sponge Composites for Selective Oil Absorption from Oil/Water Mixture
임용택, 이하진*, 최원산, 한밭대학교; *한국기초과학지원연구원 서부센터

3PS-49 According to Difference by Poly styrene-*block*-Poly-2-Vinyl Pyridine of Molecular Weight and Swelling Solution Change, Color Difference in Particle Photonic Crystal
임진엽, 신동명, 홍익대학교

3PS-50 Improvement of the electrical properties of polyamide/multi-walled carbon nanotube nanocomposites by quadruple hydrogen bonding
임현화, 한미정, 한국화학연구원

3PS-51 Hydrogel sensor based on PVA-boronic acid derivative nanocomposite for hydrogen peroxide detection
장근석, 이택승, 충남대학교

3PS-52 Prepation and Potential Bio-Application of Oligomeric Cyclodextrin-Containing Polyelectrolytes Thin Films
장윤희, 양성윤, 충남대학교

3PS-53 In-situ synthesis of luminescent organic materials based on a reactive inkjet printing approach
전성호, 이종필, 김종만, 한양대학교

3PS-54 Synthesis and properties of PVDF-*g*-VBC anion-exchange membrane
정경석, 강기원, 황택성, 충남대학교

3PS-55 Synthesis and Opto-Electronic Properties of Hole-Transporting Polyimides Derived from Imidazole-Containig Diamines
정극민, Pradip Kumar Tapaswi, Takehiko Kambara*, 이우항, Shinji Ando*, 하창식, 부산대학교; *Tokyo Institute of Technology

3PS-56 Highly Cross-linked Polymerized Films of Dicyclopentadiene Using PECVD for Anti-Corrosive Coatings
정동철, 최은정, 안종호, 송창식, 성균관대학교

3PS-57 Preparation of bipolar membrane containing LMO and ion exchange resin for Lithium recovery from seawater
정민호, 고대영, 황택성, 충남대학교

3PS-58 Surface Passivation Effect of Funcitionalized Fluornated Polymers on Organic-Inorganic Perovskite Solar Cell
정범진, 강한솔, 박철민, 연세대학교

3PS-59 Studies of Liquid Crystal Orientation Using FTIR Imaging Spectroscopy
정재현, 송기국, 배진우, 경희대학교

3PS-60 Enhanced power conversion efficiency according to the concentration of the chlorine doped zinc oxide
정재훈, 임동찬, 김민경, 한국 재료연구소 표면기술연구본부 전기화학연구실

3PS-61 Surface Functionalization of Magnetic Nanoparticles for Bio-Sensing Application
정종찬, 양성윤, 충남대학교

3PS-62 Preparation of a poly(vinyl alcohol)-based graphitic carbon nanosheet through a radiation-induced stabilization and thermal treatment
정창희, 정진묵, 홍지현*, 황인태, 정찬희, 최재학*, 한국원자력연구원 첨단방사선연구소; *충남대학교

3PS-63 The bioreducible CBA-amine polymers for gene delivery to MEF cell
정한샘, 이혁진, 이화여자대학교

3PS-64 Ion Sensitive Polypepetide Block Copolymer
정희정, 이선숙, 김혜안, 문효정, 남상아, 정병문, 이화여자대학교

3PS-65 Fabrication of Microarchitecture Consist of PEG Hydrogel and PCL Nanofiber for Cell Encapsulation and Protein Delivery
조강희, 고원건, 한상원, 김민수, 국윤민, 차성호, 윤병주, 연세대학교

3PS-66 Highly active cone-shaped nanoporous gold SERS substrates using nanosphere lithography
조경천, 김진백, 한국과학기술원

3PS-67 Size-controllable functionalized nanoporous thin film for anti-reflection by supramolecular self assembly
조석만, 송지영, 박철민, 연세대학교

3PS-68 Detection of alkali metal ion using conjugated polyelectrolyte containing crown ether
조아라, 김대근, 이택승, 충남대학교

3PS-69 Nanoporous polyimide film using one-step heat treatment of poly (ethylene glycol-*co*-imide)
조영운, 허필호, 부산대학교

3PS-70 Fabrication and properties of ultrafiltration membranes composed of carboxylic polyethersulfone and self assembly antibacterial ZnO nanoparticles
조용준, 최락원, 김창근, 중앙대학교

3PS-71 Preparation of antifouling paint resin with *tert*-butyldimethylsilyl methacrylate-*block*-polyurethane-*block*-*tert*-butyldimethylsilyl methacrylate triblock copolymer
조중현, 김대희, 박 현*, 이인원*, 전호환*, 조남주, 부산대학교; *부산대학교 첨단조선공학센터

Direct Exfoliation of Graphene using Poly(styrenesulfonic acid graft aniline)as a Surfactant and Its Application to Supercapacitor Electrode

이진우, 김경태, 조원호*
서울대학교재료공학부

Poly(styrenesulfonic acid graft aniline) (PSSA–*g*–PANI)/graphene composites were prepared through direct exfoliation of graphite using PSSA–*g*–PANI as a surfactant. Compared with other fabrication methods of PANI/graphene composites such as *in situ* polymerization and electrodeposition, the direct exfoliation method provides high quality of graphene because graphite is directly used as a precursor without chemical treatment and minimizes the fabrication step by mixing graphite and the surfactant. In a three-electrode setup, PSSA–*g*–PANI/graphene composite has a specific capacitance of 767 F/g at 0.5 A/g, which is among the highest value of supercapacitor electrodes based on PANI/graphene composites. This high value is attributed to its hierarchical structure taking advantage of high specific area of graphene and high pseudo-capacitance of PANI. Furthermore, PSSA–*g*–PANI/graphene composite retains 82% of its initial capacitance after 1000 cycles, indicating high electrochemical cyclic stability.

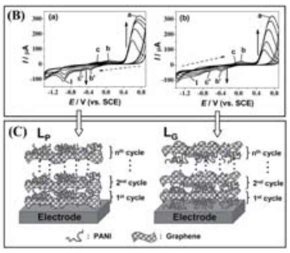
Direct Exfoliation of Graphene using PSSA–g–PANI as a Surfactant for Supercapacitor Electrode

이진우, 조원호*
서울대학교 재료공학부

Introduction

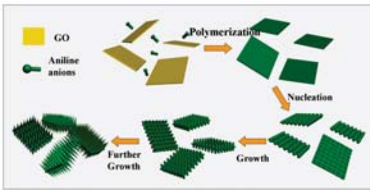
❖ Common fabrication methods of graphene/polymer composite for supercapacitor electrode

✓ Electropolymerization



Macromol. Rapid Commun. **2012**, *33*, 1780

✓ *In-situ* polymerization

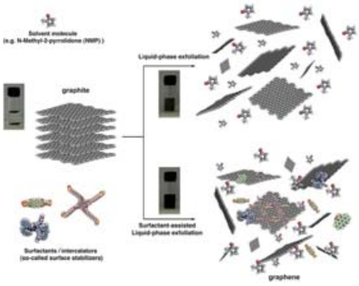


Dalton Trans. **2013**, *42*, 7854

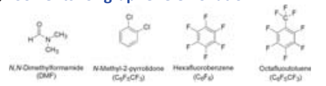
Disadvantages

- Complicated experimental steps
- Long time for fabrication of composites
- Using graphene oxide containing many defects as a precursor

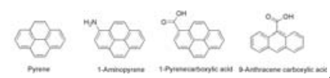
❖ Direct exfoliation methods of graphene



Solvents for graphene exfoliation



Surfactant for graphene exfoliation

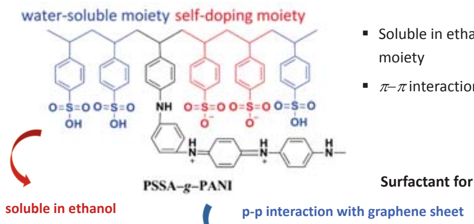


Chem. Soc. Rev. **2014**, *43*, 381

Advantages

- Production of high quality graphene
- Simple and easy fabrication
- Low cost

✓ PSSA-*g*-PANI as a surfactant for graphene exfoliation



- Soluble in ethanol due to water-soluble moiety
- π–π interaction of PANI with graphene

Surfactant for exfoliation of graphene

Chem. Commun. **2003**, *22*, 2768

Objectives

- To fabricate graphene/polymer composite using poly(styrenesulfonic acid graft aniline) (PSSA–*g*–PANI) as a surfactant.
- To investigate electrochemical properties of the composites as a supercapacitor electrode.

Results

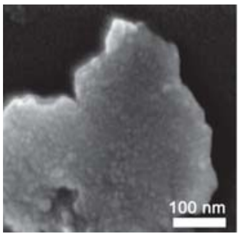
❖ Fabrication of graphene/PSSA-g-PANI composite *via* direct exfoliation

Sample preparation

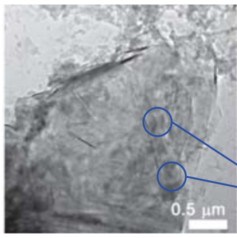
1. 100 mg of graphite and 100 mg of PSSA–*g*–PANI are dispersed in 10 ml ethanol *via* bath-type sonicator for 8 hours.
2. The dispersed solution is centrifuged for 60 min at 2000 rpm and decanted.
3. The composite is obtained by evaporation of solvent in supernatant.
4. The composite is dried at 30 °C under vacuum for 24 h.

✓ Microscopic images

▪ SEM images



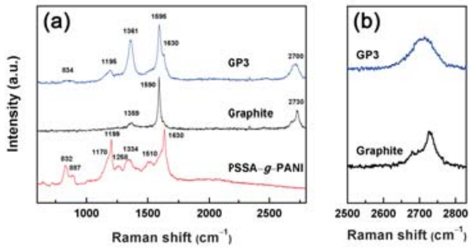
▪ TEM images



SEM and TEM images of fully exfoliated single layer graphene covered with PSSA–*g*–PANI

PSSA–*g*–PANI on graphene sheet

✓ Raman spectra

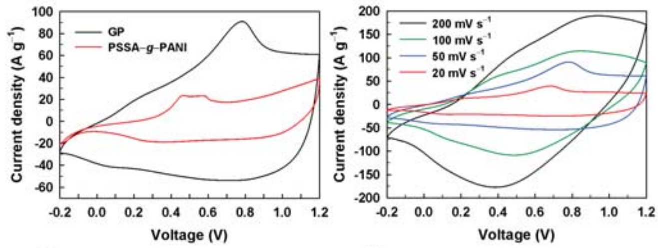


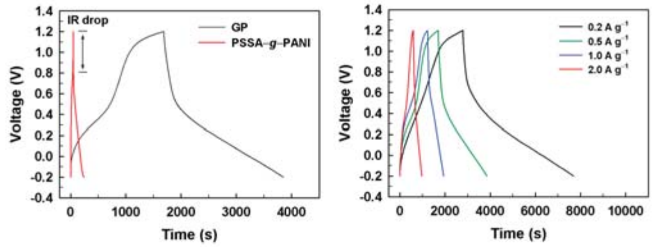
(a) Confirmation of vibrational bands of the composite (GP), graphite and PSSA-*g*-PANI

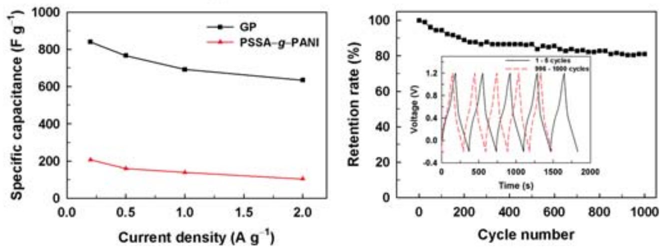
(b) Single broad peak of 2D band in GP

Indicating existence of single and bilayer graphene

✓ Electrochemical properties







- The maximum specific capacitance of graphene/PSSA-*g*-PANI composite: 767 F g^{-1} at 0.5 A g^{-1} based on galvanostatic charge/discharge test and 82% retention of the specific capacitance after 1000 cycles.

Conclusions

- graphene/PSSA–*g*–PANI composite is fabricated *via* direct exfoliation method.
- The composite exhibits the excellent specific capacitance of 767 F g^{-1} at 0.5 A g^{-1}.
- The composite retains 82% of its initial capacitance after 1000 cycles indicating high electrochemical cyclic stability.