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Applied Catalysis B: Environmental
Volume 343, April, 2024, p123568 (Impact Factor : 22.1)

Toward feasible single atom-based hydrogen evolution electrocatalysts via artificial ensemble sites for anion exchange membrane water electrolyzer

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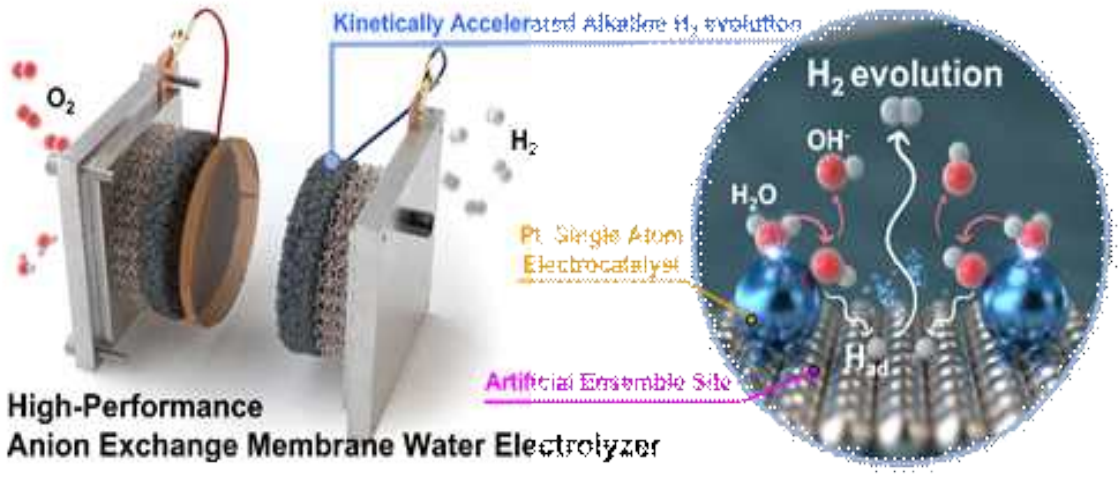
Lee Seul Oh, Changshin Jo, Chiho Kim, Hyung Ju Kim,
Sung Mook Choi*, Hyeyoung Shin*, **Seonggyu Lee***, Eunho Lim*



Approaching an efficient anion exchange membrane water electrolyzer (AEMWE) with satisfactorily high kinetics in the alkaline hydrogen evolution reaction (HER) is desired. We design an advanced platinum (Pt) single atom (SA)-based electrocatalyst by incorporating the Ni nanoparticle as an artificial ensemble site adjacent to Pt SA. The designed Pt SA electrocatalyst achieves higher areal current density (500 mA cm^{-2} at 1.8 V) in the single cell of the AEMWE and better cell voltage stability than the Pt/C electrocatalyst. The Ni nanoparticle assists in separating the binding sites of H* and OH*, in which Ni atoms provide adsorption sites for H*, while OH* adsorbs on the Pt SA. This separation effect drastically accelerates the energy barrier required for the water dissociation reaction in the Volmer step and simultaneously optimizes the H* and OH* binding energy, which extremely enhances the alkaline HER kinetics, thereby demonstrating the feasibility of Pt SA electrocatalysts for AEMWE.

태양에너지

Advanced Science
Volume 11, Apr. 2024, 2400304 (Impact Factor : 14.3)

Unveiling the Role of Side Chain for Improving Nonvolatile Characteristics of Conjugated Polymers-Based Artificial Synapse

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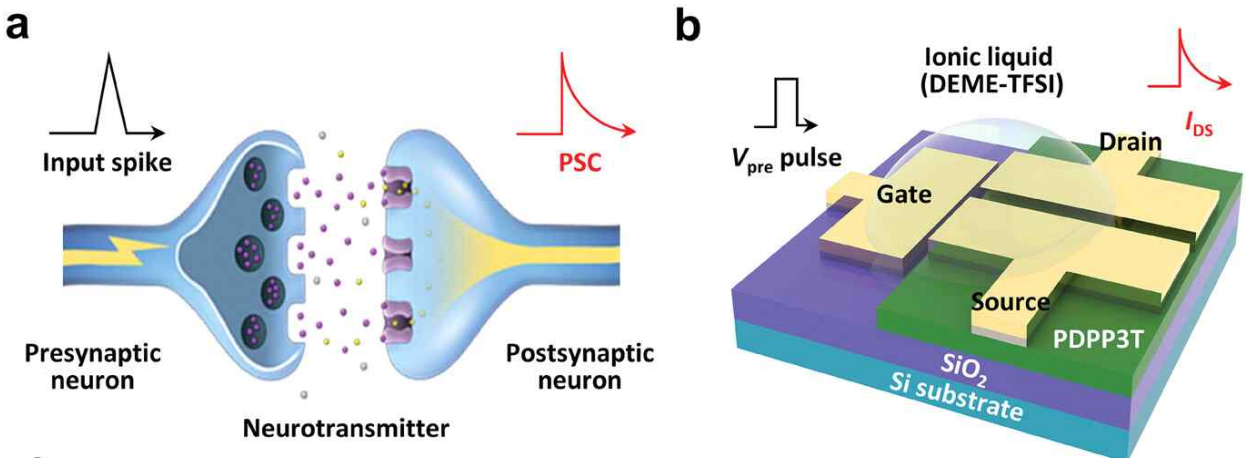

Interest has grown in services that consume a significant amount of energy, such as large language models (LLMs), and research is being conducted worldwide on synaptic devices for neuromorphic hardware. However, various complex processes are problematic for the implementation of synaptic properties. Here, synaptic characteristics are implemented through a novel method, namely side chain control of conjugated polymers. The developed devices exhibit the characteristics of the biological brain, especially spike-timing-dependent plasticity (STDP), high-pass filtering, and long-term potentiation/depression (LTP/D). Moreover, the fabricated synaptic devices show enhanced nonvolatile characteristics, such as long retention time (≈102 s), high ratio of Gmax/Gmin, high linearity, and reliable cyclic endurance (≈103 pulses). This study presents a new pathway for next-generation neuromorphic computing by modulating conjugated polymers with side chain control, thereby achieving high-performance synaptic properties.

에너지저장

Energy Materials
4, 2024, 400063 (Impact Factor : 11.8)

Recent advances in Sb-based anodes for Li/Na/K-ion batteries and all-solid-state Li-ion batteries

Jeong-Myeong Yoon, Deok-Gyu Kim, Do-Hyeon Kim, Young-Han Lee, **Cheol-Min Park***

In recent decades, lithium-ion batteries (LIBs) have emerged as a primary focus in the energy-storage field owing to their superior energy and power densities. However, concerns regarding the depletion of non-abundant lithium resources have prompted the exploration and development of emerging energy-storage technologies, such as sodium- (SIBs) and potassium-ion batteries (PIBs). In addition, all-solid-state LIBs (ASSLIBs) have been developed to address the issues of flammability and explosiveness associated with liquid electrolytes. Among the various alloy-based anodes, antimony (Sb) anodes exhibit high energy densities owing to their high theoretical volumetric capacities that are attributable to their high densities. However, Sb anodes exhibit poor cyclabilities owing to excessive volume changes during cycling. To mitigate this issue, researchers have investigated the use of diverse solutions, including solid electrolyte interface control, structural control, and composite/alloy formation. Herein, we review and summarize Sb-based anode materials for LIBs, SIBs, PIBs, and ASSLIBs developed over the past five years (2018-present), focusing on their reaction mechanisms and multiple approaches used to achieve optimal electrochemical performance. We anticipate that this review will provide a comprehensive database of Sb-based anodes for LIBs, SIBs, PIBs, and ASSLIBs, thereby advancing relevant studies in the energy-storage-systems field.

에너지변환

ACS Applied Materials & Interfaces
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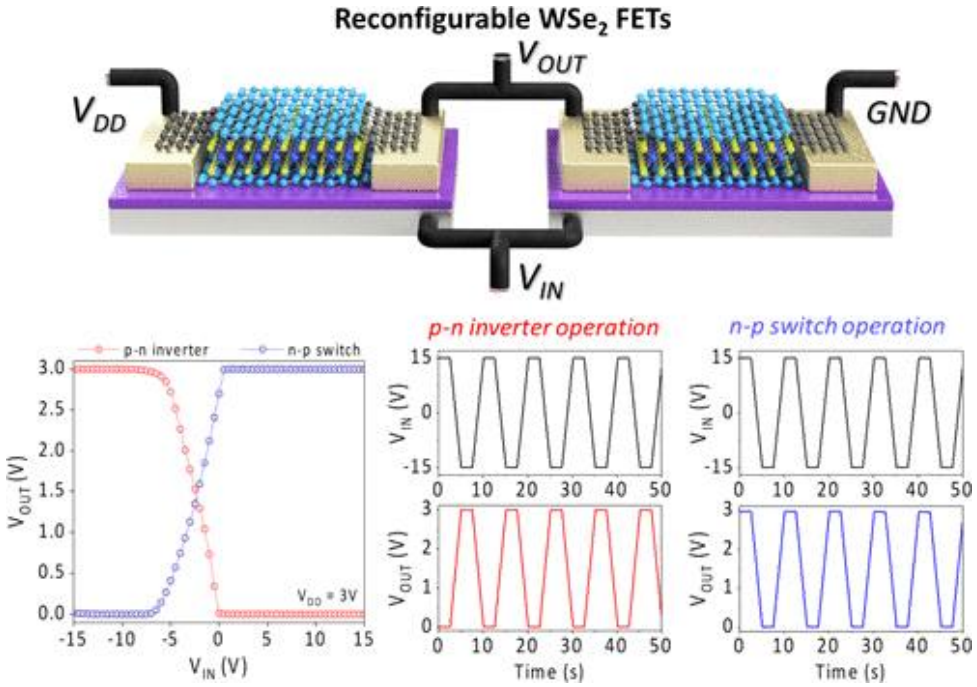
Nonvolatile Reconfigurable Logic Device Based on Photoinduced Interfacial Charge Trapping in van der Waals Gap

Sun Woo Kim, Juhyung Seo, Subin Lee, Daozhi Shen, Youngjin Kim, Hyun Ho Choi, Hocheon Yoo*, **Hyun Ho Kim***



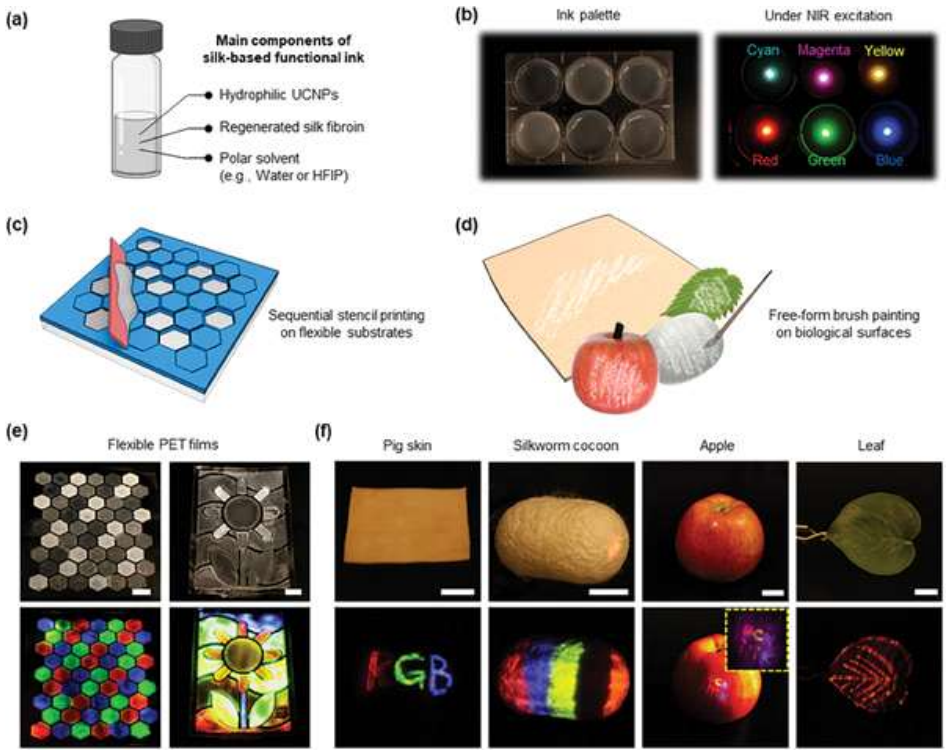
Due to the increasing complexity in miniaturization of electronic devices, reconfigurable field-effect transistors (RFETs) have emerged as a solution. Although the foundational concepts of RFETs have matured over two decades, ongoing breakthroughs are needed to address challenges such as improving the device performance as well as achieving balanced symmetry between n-type and p-type transport modes with long-term stability. Herein, we present a nonvolatile WSe2-based RFET that utilizes photoassisted interfacial charge trapping at the h-BN and SiO2 interface. Unlike typical RFETs with two gate electrodes, our RFETs achieved polarity control with a single operating gate activated exclusively under white-light exposure. The threshold voltage was tunable, ranging from 27.4 (−31.6 V) to 0.9 (+19.5 V), allowing selective activation of n-type (p-type) operation at VGS = 0 V. Additionally, our WSe2-based RFETs show superior repeatability and long-term stability. Leveraging these advantages, various reconfigurable logic circuits were successfully demonstrated, including complementary inverters and switch circuits as well as pull-up and pull-down circuits, highlighting the potential of WSe2 FETs for future advancements of integrated circuits.

에너지변환

Advanced Optical Materials
Volume 12, April 2024, 2302634 (Impact Factor : 8.0)

Silk-Based Functional Inks with Color-Tunable Light Upconversion for Printing on Arbitrary Surfaces

Junyong Ahn, **Taehoon Kim**, Fiorenzo G. Omenetto*, **Junyong Park***



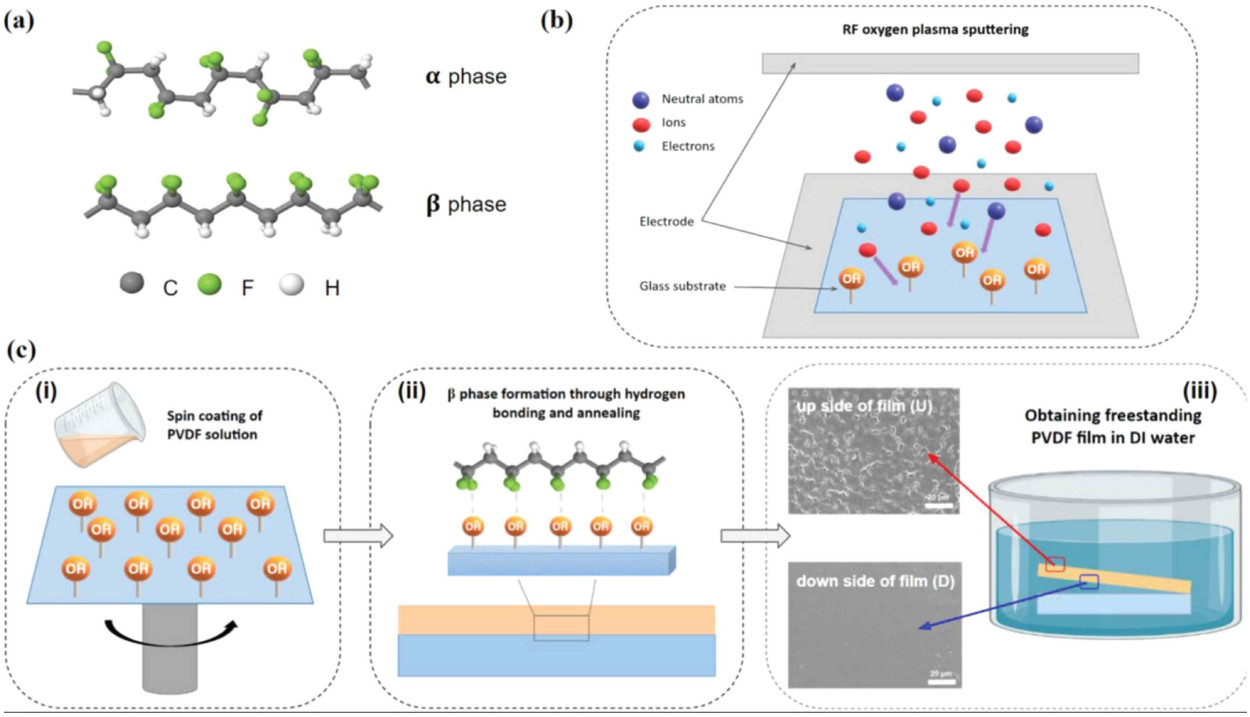
A biocompatible and versatile silk-based functional ink with hydrophilic upconversion nanoparticles (UCNPs) that can be printed or painted on arbitrary substrates, including biological surfaces is demonstrated. Hydrophilic UCNPs, ready to be dispersed in aqueous silk fibroin solution, are synthesized in large quantities via facile hydrothermal synthesis using citric acid. Based on a systematic study of dopant control to achieve robust red emission from citrate-capped UCNPs, three primary colors are obtained, which serve as the basis for the expansion of the color palette. The synthesized UCNPs are homogeneously dispersed in regenerated silk fibroin solutions derived from Bombyx mori cocoons to produce water-based functional inks. Cyan, magenta, and yellow (CMY) inks are created by combining red, green, and blue (RGB) inks. Demonstrator devices, where a variety of colorful patterns and codes are revealed only under near-infrared irradiation, are realized through stencil printing or brush painting on flexible polymer films, fruit, leaves, silkworm cocoons, and pig skin. The patterns and codes are highly heat resistant (~230 ˚C) and can be easily washed off with water after use. The printable/paintable inks and functions proposed here will provide new opportunities for applications where sustainability, biocompatibility, and intentional luminescence are simultaneously required.

에너지변환

Advanced Materials Interfaces
Volume 11, Feb. 2024, 2300727 (Impact Factor : 4.3)

A study of contact electrification process on PVDF-Metal Interface : Effect of β phase composition

Yerkezhan Amangeldinova, Jin-Woo Oh, **Wonho Lee**,
Dong-Myeong Shin*, Yoon-Hwea Hwang*



Recently, triboelectric nanogenerators (TENGs) are getting considerable attention as an energy harvesting tool that can convert random mechanical energy into electricity due to the wide material selection, low cost, and easy fabrication. TENGs work by contact electrification on the interface and electrostatic induction on the electrodes when two surfaces contact and separate. Herein, the study of the contact electrification process on the metal-polyvinylidene difluoride (PVDF) interface is conducted focusing on the effect of β phase content on the electrical properties of the PVDF films. It is found through the EFM and KPFM surface electrical studies that a higher β phase promotes stronger electrostatic interactions and enhances electron-cloud overlap with the metal coated cantilever tip that leads to higher amount of charge transfer. Additionally, there is overall enhancement of the TENGs electric output performance for a higher β phase containing PVDF films and the maximum electric output of 8.1 V and 12.2 nA is obtained for the TENG made with 79% β phase PVDF film.