PG4A : 나노 융합 세라믹스

PG4A-1 | 2차원 $SnSe_2$ 형상과 NO_2 가스 감응 특성과의 상관관계 연구

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2차원 $SnSe_2$는 높은 전기전도도를 지님과 동시에 NO_2 가스 흡착 에너지가 높아 NO_2 센서 소재로서 각광받고 있다. 그러나 현재까지 $SnSe_2$ 형상과 NO_2 가스 감지 특성과의 상관관계에 대한 연구는 미흡한 실정이다. 본 논문에서는 수열합성 공정 시간을 조절하여 $SnSe_2$ 형상을 제어하였고 이에 따른 NO_2 가스 감지 특성변화를 분석하였다. 그 결과, 반응 시간이 24시간에서 36시간으로 증가함에 따라 $SnSe_2$의 결정구조는 육방정계로 동일하게 유지되었지만 형상이 디스크(disk) 형태에서 꽃(flower) 모양으로 변화하였다. 이는 $SnSe_2$ 입자 성장 시 자발적 자기조립(self-assembly) 특성으로 인한 것으로 판단된다. 합성된 $SnSe_2$ 형상 별로 100 ppm 농도의 NO_2 가스를 노출시켰을 때 감지 특성을 평가하였다. 그 결과, 디스크 모양보다 꽃 모양의 $SnSe_2$ 감도가 22%로 약 4배 우수하였다. 더불어 꽃 형상의 $SnSe_2$는 이종 가스(H_2S, NH_3) 대비 3배 이상의 높은 선택성을 보였다. 이는 디스크 형상보다 꽃 형상의 $SnSe_2$가 높은 비표면적 특성과 낮은 결함 농도에 의한 것으로 판단된다.

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PG4A-2 | 솔-젤법을 이용한 유무기 하이브리드 코팅용액 제조 및 특성평가

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유무기 하이브리드 재료는 기존의 유기물과 무기물이 갖는 장점을 이용하고 단점을 최소화하는 복합소재로써 물리적 화학적 성질의 강화와 더불어 내오염성, 발수 특성 등 새로운 기능을 부여하여 코팅 분야에서 주목받고 있다. 본 실험에서는 유무기 하이브리드 코팅 소재를 합성하기 위해 솔-젤 공정을 이용하였으며, 테트라에톡시실란(TEOS)와 유기실란을 합성하여 차세대 자동차용 디스플레이 커버 윈도우용 유무기 하이브리드 코팅 소재 및 성형 기술을 연구하였다. 3-글리시독시프로필트리메톡시실란(GPTMS), 데실트리메톡시실란(DTMS)을 사용하여 2종 실란을 합성하였고 실란 특성이 코팅막의 특성에 미치는 영향을 관찰하였다. 딥 코팅 방법을 통해 PMMA에 코팅용액을 코팅하여 코팅막을 제조하였다. 무기물과 2종의 유기실란을 사용함으로써 우수한 연필 경도와 우수한 발수성, 투과율을 확인하였다. 제조한 코팅막의 특성 연구를 위해 접촉각, 투과율, 연필 경도를 측정하였으며 측정 결과 투과율 92.5%, 접촉각 97.0°, 연필경도 4H가 측정되었다.

PG4A-3 | Ultrahigh Current Generation of Large-Scale Monolayer MoS_2 Films with Interdigitated Electrodes

JUNG Ye Seul[1], *KIM Ji Yeon[1], CHO Yong Soo[1]
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Piezoelectricity has been explored for the electromechanical energy conversion for monolayer transition metal dichalcogenides (TMDs), which has been recognized from the structural origin, i.e., the lack of inversion symmetry. However, most studies on the power generation of TMDs has been limited to micrometer-scale single crystals. Here, we propose the superior power generating characteristics of piezoelectric nanogenerators based on centimeter-scale monolayer MoS_2 film for the first time. Utilization of Na_2S as growth promoter enables the synthesis of higher-quality monolayer since extra sulfur atoms critically compensate for the intrinsic sulfur vacancies. Due to the high-level coverage of the large-scale monolayer film specifically with interdigitated electrode pattern, the resultant electromechanical energy generators with an unprecedented large active area of 18.3 mm^2 demonstrated the output voltage of a ~400.4 mV and output current of ~40.7 nA, which are the highest values relative to the reported outcomes for the 2D materials.

PG4A-4 | Polymer-Encapsulated Halide Phosphors for White Luminescence

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Inorganic perovskite halide nanocrystals have emerged with a great promise as light source for white LEDs due to their outstanding optical features, such as high photoluminescence quantum yields, tunable band gaps, and narrow emission line widths. However, chemical degradation of the halides leads to poor stability of devices that can hinder their applicability. Here, we present an all-halide-phosphor-layered composite consisting of inorganic green and red nanocrystals embedded in an UV-cured polymer matrix to create true white luminescence. White luminescence characteristics were investiagted by changing the relative portion of the halide nanocrystals and the thickness of the phosphor composite with additional adjustments of a polymer encapsulation layer and a prismatic pattern.. An approximately 20% increase in luminescent efficiency was achieved by applying the prism pattern with a 9 μm pixel size for the top red layer, reaching an efficacy of 54.4 lm W^{-1} with true white characteristic

The adotopn of the prsmatic pattern contributes to the reduction intotal internal reflection. Meanwhile, an applied encapsulation layer of polydimethylsiloxane (PDMS) covering the both sides of the composite layers was effective in maintaining the luminescence characteritics up to 300 h.

PG4A-5 | The design of ZnSe:Mn2+/ZnS core/shell quantum dot with large Stokes shift and enhanced quantum yield

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Luminescent solar concentrators (LSCs) are recognized as the one of facinating system in photonic devices. For utilization of luminescent materials in LSCs, the development of large Stokes shift materials is essential to hinder self-quenching effect resulted from reabsorption. In this works, ZnSe-based quantum dots (QDs) were synthesized by doping the Mn^{2+} ion. By doping Mn^{2+} ions, ZnSe:Mn^{2+} QDs can be not only controlled emission property but also increased their Stokes shift. Then, by the ZnS shell growth on the ZnSe:Mn^{2+} core, ZnSe:Mn^{2+}/ZnS QDs showed the greatly increased quantum yield. Furthermore, the ZnSe:Mn^{2+}/ZnS QDs exhibited a large Stokes shift, indicating that ZnSe:Mn^{2+}/ZnS QDs can be utilized in the LSCs. The LSCs film fabricated by embedding the ZnSe:Mn^{2+}/ZnS QDs into polymer showed the high transparency. These results can contribute the crucial insight for the development of QDs with controlled optical properties as well as potential to utilize QDs in LSCs.

PG4A-6 | Li-intercalation and Chemical exfoliation of MoS_2

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MoS_2, an outstanding member of the Transition Metal Dichalcogenide (TMDC) materials, has garnered significant attention in research. Alongside graphene, TMDC materials share the trait of thinness and exhibit remarkable semiconductor properties. For instance, MoS_2 can transition its bandgap from an indirect bandgap (~1.3 eV) in bulk structure to a direct bandgap (~1.8 eV) in monolayers, rendering it a crucial material in the electronics industry. In this study, we synthesized single-crystal bulk MoS_2 using the molten salt flux method. This served as a precursor for Li-intercalation through n-Butyllithium, followed by chemical exfoliation under ultrasonic conditions. X-ray Diffraction (XRD) analysis of the bulk MoS_2 indicated a preference for single crystal planes to grow in the (00l) direction. Raman spectroscopy revealed the presence of the phonon modes E^1_{2g} and A_{1g} at wavenumbers of 383 cm^{-1} and 410 cm^{-1}, respectively. Additionally, X-ray Photoelectron Spectroscopy (XPS) data provided insights into the binding energies of Mo 3d and S 2p. The exfoliated MoS_2 was characterized using Field Emission Scanning Electron Microscopy (FESEM) and Transmission Electron Microscopy (TEM). The results demonstrated the successful harvest of several layers of exfoliated MoS_2.

PG4A-8 | 용융염 용매 효과를 이용한 $Li_7La_3Zr_2O_{12}$ 고체 전해질의 이온 전도도 향상 및 미세 구조 제어 연구

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최근 고체 이온 전도체를 사용하는 전고체배터리는 높은 에너지 밀도와 향상된 안전성을 특징으로 하는 유망한 차세대 전기화학 장치로 부상하였다. 특히, $Li_7La_3Zr_2O_{12}$ (LLZO)와 같은 가넷 구조의 세라믹 소재는 우수한 대기 및 습도 안정성과 넓은 전기화학적 안정성 범위를 갖고 있어 이러한 배터리를 구현하는데 적합한 소재로 평가된다. 그럼에도 불구하고, LLZO는 황화물 기반 고체 전해질에 비해 상대적으로 10^{-4}에서 10^{-5} S/cm 범위의 낮은 이온 전도도를 나타낸다. 우수한 리튬 이온 전도도를 달성하기 위한 방안은 혼합 상보다 단일 입방체 LLZO 상을 형성하는 것이 유리하다. 이 접근 방식은 고체 전해질 내에서 큰 접촉 면적과 효율적인 이온 이동 경로를 확보하기 위한 목적을 가진다. 본 연구에서는 용매 효과를 이용한 용융염합성법을 사용하여 LLZO를 제조하였다. 이 방법은 높은 에너지 전달 및 단축된 확산 경로를 활용하여 고온 소성 공정에서의 불필요한 상전이 및 혼합상 생성을 방지할 수 있으며 미세 입자 크기를 조절하는 것에 유리하다. 샘플의 미세구조는 주사 전자 현미경 (SEM) 및 투과 전자 현미경 (TEM)을 사용하여 특성화되었으며, 상 구조는 X선 회절 (XRD) 분석을 통해 분석되었다. 또한 전기화학 임피던스 분광법 (EIS)을 사용하여 실온에서 리튬 이온 전도도를 측정하였다. 결과는 LZO 중간상이나 정방정계 LLZO 상의 생성 없이 단일 입방체 상으로 LLZO가 형성되었음이 확인되었다. 특히, LLZO의 평균 입자 크기는 기존 고상 합성 방법과 비교하여 5 μm에서 약 1 μm로 크게 감소했다. 게다가, 실온에서의 이온 전도도는 7×10^{-3} S/cm 범위 내에 있음이 확인되었다. 이러한 결과는 용융염 합성법의 효과를 강조하며, LLZO의 미세 구조를 조절하고 단일 상 형성을 통해 우수한 이온 전도도에 달성할 수 있는 가능성을 보여준다. 더욱이, 이 접근법은 용융염이 고온에서 액상화되고 합성이 용이해지는 용매 효과를 활용한다는 점을 강조한다. 이러한 전략은 고체 전해질을 효과적으로 생산하기 위한 유망한 방법으로서 전고체배터리 기술 분야를 발전시키는데 활용될 수 있다.

PG4A-9 | Large-scale Production of Carbon Nanotube Fibers using Artificial Neural Network Model

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Carbon nanotube (CNT) fibers (CNTFs) have excellent properties, and floating-catalyst chemical vapor deposition (FCCVD) is the mostly used method for CNTs and CNTFs. However, several parameters involved in the synthesis process make it difficult to predict the yield and quality of CNTFs. Artificial neural network (ANN) model has used to make predictions of the carbon materials properties. Optimal condition and dependence of parameters was investigated by using ANN model. Concave curve predicted from the ANN model showed that the solution injection rate affected the linear density, revealing that 0.2 ml/min was the ideal injection rate to achieve the highest linear density. The solution composition, according to ANN model, has no discernible impact on the linear density of CNTFs. We anticipate that researchers working on the synthesis of CNTs and CNTFs will benefit from the ANN model's ability to predict the ideal state of their system during the synthesis.

PG4A-10 | Deep-Injection Floating-Catalyst Chemical Vapor Deposition 방법을 이용한 고 반응효율 탄소 나노튜브 합성

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Invention of DI-FCCCD (Deep-injection floating-catalyst chemical vapor deposition) method dramatically improved productivity and quality of carbon nanotubes (CNTs), but DI-FCCCD method have several limitations in increasing residence time of materials, so high reaction efficiency can not be expected. In this study, conditions for obtaining high reaction efficiency were investigated by controlling total flow rate and synthesis temperature. Reduction of total flow rate increased concentration of reactants per time, so reaction efficiency was increased by reducing methane and increasing synthesis temperature. We also tried feeding more ferrocene, because simulation results showed that low total flow rate we chose did not significantly affect temperature profile inside injection tube. As a result, CNT synthesis condition with high carbon conversion rate (~36%) was obtained. In this study, we suggested ways to increase reaction efficiency and carbon conversion rate when synthesizing CNTs using DI-FCCVD method, and presented industrial potential of DI-FCCVD method.

PG4A-11 | Pyroelectric zinc oxide (ZnO) induced by human breath integrated on a face mask for applications in bioprotection.

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The rapid dissemination of infectious ailments stands as a formidable global peril, profoundly affecting human well-being, sustenance, and economic equilibrium, as underscored by the emergence of the coronavirus disease 2019 (COVID-19) pandemic. Despite the widespread utilization of face masks to physically obstruct pathogens, their capacity for direct disinfection remains marginal. In this context, we propose a composite material featuring biocidal zinc oxide (ZnO) nanorods embedded within paper (termed ZNR-paper). This composite material (1) becomes an integral component of facial masks, (2) generates heat propelled by respiratory exhalations, (3) fosters the production of reactive oxygen species (ROS), and (4) exhibits pronounced antibacterial and antiviral attributes. We affix the ZNR-paper composite onto facial masks, specifically within the region adjacent to the nasal and oral areas, characterized by pronounced curvature and subject to considerable compressive and tensile strains. We explore the influence of pre-existing strain on subsequent pyroelectricity arising from breathing-induced thermal fluctuations, focusing on variations in Zn-O bond lengths and O-Zn-O bond angles. This distortion of the structural arrangement of ZnO within the curved composite material suggests heightened polarization, conceivably augmenting the ensuing pyroelectric response. Experimental validation of enhanced pyroelectric properties is corroborated through efficient ROS generation, thereby establishing a notable degree of bioprotection. Keywords: human breathing, pyroelectric ZnO nanorod, face mask, ROS production, antibacterial and antiviral functions

PG4A-12 | Controlling the Thermal Conductivity of SiO_2 Aerogel Via Parylene-N deposition

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This research investigation is centered upon the thermal characteristics of SiO_2 aerogels, specifically those

derived from waterglass and tetraethylorthosilicate (TEOS). The study encompasses an examination of these aerogels both prior to and subsequent to their application of parylene coatings, accomplished through two distinct methods: thermal deposition and plasma deposition. The compositions of the resulting aerogels were subject to scrutiny via scanning electron microscopy. In the course of employing thermal deposition, it was observed that when the thickness of the parylene coating exceeded 50 nm, the pore structures within the aerogels underwent dissolution. In contrast, the adoption of parylene coating through plasma deposition led to a more effective preservation of the pore structures, a phenomenon substantiated by the outcomes of Brunauer-Emmett-Teller analysis. Furthermore, the thermal conductivity of the SiO_2 aerogels was quantitatively evaluated employing differential scanning calorimetry analysis. The findings revealed that the introduction of plasma-deposited parylene coating exerted a noteworthy influence upon the thermal attributes of the waterglass- and TEOS-based SiO_2 aerogels. This influence was most pronounced at an optimal thickness of parylene coating, yielding the minimal thermal conductivity and thereby augmenting thermal insulation capabilities. The study underscores the efficacy of employing parylene-N coating as a modulating factor in the manipulation of thermal conductivity within SiO_2 aerogels generated from both waterglass and TEOS precursors, while remaining within a designated range. It is worth noting that the alteration in the thermal characteristics of SiO_2 aerogels with parylene coating varies depending on whether the coating process involved thermal or plasma deposition methodologies.

Keywords : Aerogel, Thermal conductivity, Parylene-N, Plasma deposition, DSC

PG4A-13 | 코발라이트-CuS 수계용 세라믹 쉬트 제조

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p.p1 {margin: 0.0px 0.0px 0.0px 14.9px; text-align: justify; text-indent: -14.9px; line-height: 20.0px; font: 10.0px KMU} span.s1 {color: #374151} Covellite(CuS)는 황화물 중 하나로, 광열전환, 전극, 비선형 광학 물질, 태양광 컨트롤러, 태양광 흡수체, 촉매, 나노 스케일 스위치 및 리튬 이차 전지 고용량 양극 재료 그리고 센서등 다양한 응용성을 가지고 있으며, chalcocite(Cu_2S)는 p형 반도체로 태양전지, 광촉매, 바이오센서 및 광전자 소자 등에 이용 가능성을 갖는 재료이다. 본 연구에서는 일차적으로 Cu, S, Di-water 를 출발물질로 수열합성법을 적용하여 나노 크기의 covellite(CuS) 나노분말을 합성하였다. 수열합성 공정에서의 열처리 온도, 열처리 반응 시간등 최적 공정 조건을 확립하였다. 제조된 covellite(CuS) 나노분말을 이용하여 CuS 세라믹 쉬트를 제조하였으며, 수계용 닥터블레이드 테이프 캐스팅 방법을 적용하여 위한 결합제, 분산제등의 유기 첨가물에 대한 최적 조건을 확립하고자 하였다. Covellite(CuS) 세라믹 쉬트의 열처리 온도 변화에 따른 결정구조, 미세구조 변화 및 항균 특성 변화에 대한 연구를 수행하였다. 최종적으로 COVID19 팬데믹으로 야기된 항균 제품에 대한 관심과 수요에 대응하기 위하여 무기 항균소재로의 적용을 위한 쉬트형 (10cm x 10cm) Covellite(CuS)의 항균 특성을 분석하였다.

PG4A-14 | Manipulating metastable piezochromic $CoMoO_4$ crystal structure

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Transition metal molybdenum oxides($TMoO_4$) show piezochromic properties, in which change phase and colour when appropriate pressure is applied due to cation distance decrease resulting in d-orbital splitting. Therefore, the $TMoO_4$ group coexists in two phases, including the metasable phase in ambient condition, However, handling the metastable phase is difficult because of its high pressure sensitivity. Here, we doped nitrogen group elements (N, P, Sb) in the metastable $CoMoO_4$ phase, resulting in phase stabilization. Phase stabilization is confirmed by analyzing crystal structure using XRD, Raman spectroscopy, and intrinsic magnetic properties using MPMS. Moreover, nitrogen element doping causes Mo 6+ to 5+ oxidation state change, enhancing electrochemical reactivity. Using nitrogen element doped $CoMoO_4$ as an anode material, electrochemical properties were measured. Stabilized $TMoO_4$ materials show the hidden nature of piezochromic materials, proposing potential applications in smart materials and energy devices.

PG4A-15 | 결정질 고체 산화물 내 2차원 격자 결함에서의 premelting 현상에 대한 원자 수준 직접적 관찰

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Since the early 1900s, Lindemann and Born introduced two key criteria to explain the process of melting. Subsequently, a number of simulations and observations have been conducted to unravel the phenomena of premelting, primarily occurring at crystal surfaces and grain boundaries just before reaching the bulk melting point. While the possibility of triggering melting through

dislocations and clusters of vacancies and interstitials was theorized, empirical evidence directly linking premelting to lattice defects within crystals has remained elusive. In this study, we utilize atomic-column-resolved imaging through scanning transmission electron microscopy in polycrystalline $BaCeO_3$. Our findings shed light on the inception of melting within the crystals occurring at temperatures below the melting point. Notably, we establish that melting progresses in a layer-by-layer fashion rather than random nucleation during the initial stages. By underscoring the significance of precise atomistic observation, our investigation emphasizes the importance of considering lattice defects within crystals as crucial nucleation sites for phase transformations, including the process of melting.

PG4A-16 | A phase tuning approach to optimize electrocatalyst performance of MoS_2 nanosheets

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Transition metal dichalcogenides have attracted tremendous research interest owing to their useful functionalities as noble-metal-free electrocatalysts. Despite of numerous advantages of transition metal dichalcogenides, these materials suffer from critical limitations such as structural instability and insufficient activity. In effort to enhance the applicability of transition metal dichalcogenides, we develop a phase-tuning approach of interlayer-expanded MoS_2 nanosheets via defect-assisted boride substitution. The $NaBH_4$ treatment for tetrapropylammonium-restacked MoS_2 nanosheets allows to substitute boride ions into the anion vacancies of MoS_2 nanosheets due to formation of coordinate bonds with the Mo defect sites. The boride substitution results in an increase in concentration of active sites for hydrogen evolution reactions. Additionally, the resultant adjustment of 1T'/2H phase ratio improves structural stability and charge transfer kinetics. The present defect-assisted boride substitution approach can provide an effective method to explore high-performance noble-metal-free electrocatalysts.

PG4A-17 | Single-Crystal Microcubes of (K,Na)NbO3 Prepared through Molten-Salt Processing

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Potassium sodium niobates, a subgroup of perovskite oxides, have attracted considerable attention due to their versatile range of functional properties, including piezoelectricity, piezo-catalysis, ceramic capacitor capabilities, and sensing functionalities. These attributes are significantly influenced by various material characteristics, such as composition, crystallinity, crystal structure, and dimensions. Notably, single-crystal materials exhibit distinct characteristics compared to their polycrystalline counterparts. The latter consists of metastable states interspersed with grain boundaries that hinder the efficient transport of charge carriers, phonons, and plasmons. However, achieving cost-effective fabrication of single-crystal materials remains an ongoing challenge. In this context, we present a straightforward molten-salt synthetic approach devised for generating single-crystal microcubes of potassium sodium niobate. This method combines the advantages of cost-effectiveness, time efficiency, operational simplicity, and reproducibility, emerging as a robust avenue for material synthesis. We elucidate the procedure for molten salt synthesis, outlining the steps to produce single-crystal microcubes of potassium sodium niobate while delving into the underlying growth mechanism. The outcomes of this study furnish valuable insights and synthetic strategies of broader relevance for the production of single-crystal microcubes using other perovskite oxide materials.

PG4A-18 | Galvanic Replacement of Copper Nanostructures into Other Metals and Their Optical Properties

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Attaining precise control over metal nanostructure morphology is pivotal for tailoring their chemical, physical, and optical properties to specific applications. The induction of anisotropic geometry in these structures, capable of eliciting unique optical characteristics through localized surface plasmon resonance (LSPR), is of particular significance. However, generating anisotropic morphologies (e.g., 1D, 2D) in metal nanostructures remains challenging due to their intrinsic symmetric cubic crystal lattice. Chemical transformation emerges as a potent strategy for crafting anisotropic morphologies (1D, 2D) beyond the reach of conventional synthesis. This presentation outlines a strategic framework to selectively influence the evolution of 1D and 2D metal nanostructures, with a primary focus on Copper (Cu) nanostructures. A subsequent chemical transformation, employing galvanic replacement, seamlessly converts these Cu nanostructures into alternative noble metals or versatile metal alloys while retaining their distinctive anisotropic structures.

Notably, a comprehensive exploration of the adjustable optical properties displayed by these nanostructures, intricately tied to their specific morphologies and compositions, is highlighted. The implications of these findings strategically position them to catalyze inventive progress across various applications including optical sensing, photonic communication, and optoelectronic devices.

PG4A-19 | Comprehending Improved Low-Field Magnetic Hyperthermia through Facet Controls of Monodisperse MnZn Ferrite Nanocubes

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Magnetic nanoparticles have garnered significant interest due to their intrinsic properties, which depend on factors such as size, shape, and composition. Specifically, Mn–Zn ferrite nanoparticles have captured attention as hyperthermia agents because of their high specific absorption rate (SAR) and strong biocompatibility. Although various synthetic approaches have been developed to achieve highly efficient induction heating characteristics by controlling metal ion doping, the lack of reproducibility in synthesizing monodisperse magnetic nanoparticles remains a persistent issue for enhancing magnetic hyperthermia. In this study, we investigate the impact of synthetic parameters on the magnetic hyperthermia performance of Mn-Zn ferrite nanocubes, demonstrating a high intrinsic low power range of 5.1 nHm2/kg at HappFapp = 1X10^9 A/ms. The optimized synthetic conditions enable a 50-fold increase in heating induction compared to commercial magnetic hyperthermia agents. We elucidate the critical roles of precursor nature, heating rate, and the reductive-oxidative environment during the organic phase synthetic process, as these factors significantly influence enhanced heat induction characteristics. Our findings provide insights into the mechanisms underlying size and shape control of Mn-Zn ferrite nanocubes and outline a systematic approach to synthetic procedures, essential for achieving phase-controlled ferrite nanocubes. This work is pivotal for advancing magnetism and realizing enhanced heating induction in applications such as magnetic hyperthermia.

PG4A-20 | Structural-defect Engineering of TiO2-x nanosheets via Li-ion implantation

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Structural-defect engineering is a crucial factor in overcoming the disadvantages of the physical and chemical properties in metal oxide semiconductor materials. Among the various electrochemical processes, the Li-ions implantation technique can enhance the physical and chemical properties by controlling factors related to structural defects, such as the surface area, particle size, morphology, and crystal structure. In this study, we fabricated TiO_2 nanosheets using a chemical exfoliation method and then conducted Li-ion implantation to control structural-defects of TiO_2 nanosheets.

PG4A-21 | A universal strategy to improve the functionality of membranes through atomic layer deposition of metal oxides

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Porous membranes play a crucial role in fluid purification and impurity separation. With applications spanning environmental and energy sectors, these membranes hold significant relevance to our daily lives. The efficacy of porous membranes in filtration hinges on their stability across varying environmental conditions, encompassing temperature and chemical compatibility. While polymer-based membranes offer cost-effectiveness advantages over inorganic alternatives like ceramics, their susceptibility to challenges related to thermal and chemical stability has been a limitation. In this study, we introduce a groundbreaking approach to address these limitations. Utilizing atomic layer deposition (ALD), we have successfully and conformally deposited an inert ceramic oxide passivation layer approximately 60 nm thick onto the surface of polymer membranes. This ceramic oxide shell, with a nominal thickness of about 60 nm, serves as a robust shield that not only effectively safeguards the polymer core from chemical species and heat transfer but also significantly enhances the overall durability and thermal stability. Rigorous testing validates the application potential of the resulting composite membranes across a wide spectrum of microfiltration scenarios, including particulate matter filtration and wastewater treatment. The integration of the ceramic oxide passivation layer, achieved through ALD, presents a pivotal advancement in reinforcing the resilience of polymer membranes. This approach pave the way for expanded applicability in diverse sectors.