SS12B : 극한물성 소재 초고부가 부품 KIURI 연구단

SS12B-1 | Real-time in vivo monitoring of intraocular pressure distribution in anterior chamber and vitreous cavity for diagnosis and treatment of glaucoma

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Glaucoma causes irreversible vision loss due to optic nerve damage and retinal cell degeneration. Since high intraocular pressure (IOP) is a major risk factor for glaucoma development, accurate IOP measurement is crucial, especially intravitreal IOP affecting the optical nerve and cells. However, conventional methods have limits in selectively and directly detecting local retina pressure. Herein we present real-time measurements of local IOP distribution in the anterior chamber and vitreous cavity of living animals using minimally invasive probes with pressure-sensitive transistors. After inducing glaucoma in animal models, we compared the local IOP distribution between normal and glaucomatous eyes. The distribution of IOP in vitreous cavities and anterior chambers were compared with tonometer measurements. Glaucoma induced higher IOP in the vitreous chamber than in the anterior chamber, indicating that measuring IOP in the vitreous chamber is key to the glaucoma model. This progress offers new directions for diagnosis and treatment of glaucoma.

SS12B-2 | Novel synthesis and deposition methods of various semiconducting metal oxide nanostructures

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Several strategies have been proposed for the synthesis and application of functional semiconducting metal oxides, such as direct substrate growth and flame chemical vapor deposition (FCVD). In the direct substrate growth method, the melting point of the substrate could be lowered according to the principle of a binary phase diagram at the interface between metal and substrate. On the other hand, the FCVD method was applied to increase the efficiency of light emitting devices and gas sensors by using additional principles such as direct energy injection, water quenching, noble metal catalyst embedment, capillary phenomenon, and two channel mode, respectively. In this way, efforts to develop new nano-synthetic methods capable of freely controlling morphology, composition, crystallinity, etc. should continue in the future in order to overcome the current limitations of semiconductors.

SS12B-3 | Photoluminescence Stability and Synthesis of Monodisperse Quantum Dots

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Luminescent semiconductor nanoparticles called quantum dots (QDs) have drawn interests in many fields due to their unique optical properties. For device application of QDs, understanding stability of QDs aginst external conditions such as oxygen, water, heat, UV exposure, and acidity is important. Various methods have been reported to enhance the stabilites of QDs including shell synthesis, ligand engineering, and encapsulation. Herein, we intrduce an experimental study of photoactivation phenomenon of QDs under heat and moisture. Furthermore, a method to enhance the stability under heat and moisture is proposed using thermo- responsive polymer (poly-n-isopropylacrylamide). Finally, a synthesis method to produce monodisperse and stable QDs is introduced which includes tuning the stability of meta-stable intermediate particle called magic-sized clusters (MSCs).

SS12B-4 | Effect of pre-reduction degree & gangue composition on the melting behavior of partially reduced iron (PRI) powder pellets

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Iron ore is a traditional source of iron used in steelmaking. In a typical reduction process, coke is used to reduce iron ore, which emits a large amount of CO_2 and has a great impact on global warming. By reducing with hydrogen instead of coke and emitting H_2O instead of CO_2, greenhouse gas emissions can be reduced. Alternatively, alternative iron sources can be used instead of iron ore to increase the pre-reduction degree (PRD) of the iron source and reduce the amount of CO_2 emitted. Alternative iron sources include PRI (partially reduced iron) and scrap. In the case of PRI, iron ore is directly reduced by natural gas or hydrogen to increase the pre-reduction degree, and impurities mainly contain P and S. In the case of scrap, the preliminary reduction rate is high, and impurities mainly contain residual elements such as Cu, Sn etc. The slag formation behavior during reduction depends on the type of gangue material contained in the iron source. In this study, the melting behavior was observed with a hot stage microscope while

heating the PRI produced by direct reduction with hydrogen in an Ar atmosphere. In addition, the FactSage program was used to predict slag formation behavior depending on the pre-reduction rate and gangue composition (SiO_2/Al_2O_3). The conditions under which the calculation was made were 50<PRD≤90 and 0.6≤ SiO_2/Al_2O_3≤6.

SS12B-5 | Electrodeposited Iridium Oxide Thin Films: Synthesis, Properties and Applications

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Iridium Oxide (IrO_2) is a metal oxide with a rutile crystalline structure, similar to TiO_2. Its metallic conductivity and low surface work function, along with high chemical stability, make it a promising candidate for various applications. IrO_2 can be synthesized in various nanostructures, including nanopowder, nanosheets, nanotubes, nanorods, nanowires, and nanoporous thin films, which can further enhance its intrinsic properties. Among them, IrO_2 thin films have demonstrated utility in various fields, such as electrocatalysis, electrochromic devices, sensors, fuel cells, and supercapacitors. Here, we present a method for electrodeposition of IrO_2 films on Au using an aqueous solution of Ir complex. The electrochemical properties of the electrodeposited oxide were investigated using cyclic voltammetry and impedance spectroscopy and found to be similar to those of activated IrO_2. The stability of the electrodeposited IrO_2 was also tested. Overall, the electrodeposition method provides a promising approach for the fabrication of IrOti films for various applications, including neural stimulation.

SS12B-6 | Enhancing Gas Sensor Performance with Novel Metal Oxide nanosheet

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This study focuses on enhancing gas sensor performance through the utilization of novel metal oxide composites. Traditional support materials have been surpassed by the development of these exceptional solutions. The research involves the synthesis of PtO2-x nanosheets, consisting of Pt, Ti, and O elements, along with TiO_2 particles. These composites exhibit outstanding properties, leading to improved gas reactivity across various gases such as Acetone, H_2S, CO, H_2, formaldehyde, toluene, and benzene. The transition from conventional metal oxide support materials to these innovative composites promises significant advancements in gas sensor technology.

SS12B-7 | Observation of cation vacancy and ferromagnetism in Ag_2Se

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In some oxide materials, oxygen vacancy plays an essential role in many physical properties, including magnetism. Meanwhile, cation vacancy is rarely observed or explored. We intend to induce Ag vacant sites in Ag_2Se semimetal by synthesizing the Ag_2Se with an excessive amount of Se. Various measurements are conducted to detect the signal of vacancies. From the measurements from three different methods, we conclude that Ag vacancies exist in the samples. The magnetizations of these samples are measured by the Superconducting Quantum Interference Device (SQUID) of the Magnetic Property Measurement System (MPMS3, Quantum Design) from 2 K to 300 K. Weak, but clear ferromagnetism with coercive field ~ 260 Oe is observed at 2 K. The ferromagnetism survives up to room temperature. We find that the ferromagnetism disappears after annealing at 488 K which is well above its crystal structure phase transition temperature. This observation supports the imperfection-induced ferromagnetism.