

Wednesday Afternoon Poster Sessions

Nanomaterials

Room: Mauka - Session NM-WeP

Nanomaterials Poster Session

NM-WeP1 Facile Preparation of $(\text{NH}_4)_2\text{SiF}_6$ Particles with High Fluorescence Quantum Yield, *Shun Kitazawa, K. Sato*, Tokyo Denki University, Japan, *N. Fukata*, National Institute for Materials Science, Japan, *K. Hirakuri*, Tokyo Denki University, Japan

Fluorescence materials are used for a broad range of industry and biomedical technology applications involving electroluminescent displays and fluorescent contrast dye of bioimaging. However, they are confronting some serious problems, such as complicated preparation techniques and low production yield. Therefore, it is necessary to develop new synthesis approaches for realization of facile preparation and large-scale production of fluorescence materials. We have prepared ammonium hexafluorosilicate ($(\text{NH}_4)_2\text{SiF}_6$) particles as one of the fluorescence materials using a chemical route with good productivity. These $(\text{NH}_4)_2\text{SiF}_6$ particles possess excellent advantages such as high-efficiency fluorescence and long-term photostability compared to the other silicon (Si)-based fluorescence materials. In this presentation, we propose a new way to fabricate $(\text{NH}_4)_2\text{SiF}_6$ particles by simplified procedures based on a chemical approach. The features of our synthesis technologies are to adopt the simplified synthesis system in which only Si powders and chemicals consisting of nitric hydrofluoric acid solution were hermetically sealed in polymeric container without any vacuum systems. The $(\text{NH}_4)_2\text{SiF}_6$ particles with mean diameter of approximately 700 nm were densely deposited on the Si substrate by using this novel synthesis system. The crystalline structures and the chemical compositions of $(\text{NH}_4)_2\text{SiF}_6$ particles were confirmed by X-ray diffraction (XRD) patterns and Fourier transform infrared (FTIR) spectroscopy. The XRD patterns were consistent with the sharp diffraction peaks derived from the cubic phase of crystalline $(\text{NH}_4)_2\text{SiF}_6$ with space group of $\text{Fm}\bar{3}\text{m}(225)$. For the FTIR characterization, the absorption peaks related to the SiF_6^{2-} and NH_4^+ ions in addition to N-H mode were also observed. These results demonstrate that the $(\text{NH}_4)_2\text{SiF}_6$ particles are not only maintained high crystallinity but also composed of ammonium and silicon fluoride as major ingredients. Such $(\text{NH}_4)_2\text{SiF}_6$ particles exhibited bright reddish orange fluorescence with a peak wavelength at 630 nm under the irradiation of xenon lamp equipped with optical bandpass filter of 365 nm. The main advantages of $(\text{NH}_4)_2\text{SiF}_6$ particles are to attain the high fluorescence quantum yield of 34 %. Additionally, the fluorescence intensity was maintained about 80% of the initial maximum intensity even after aging beyond six months. Therefore, our suggested synthesis technologies can provide a new chemical route for the fabrication of high-brightness and stable fluorescence particles.

NM-WeP2 The Flashover and Hydrophobicity Recovery Characteristics of RTV Silicone Rubber Nanocomposites, *K.J. Lim, JiSung Park, J.H. Kwon*, Chungbuk National University Korea, Republic of Korea

Many researches about silicone rubbers which are applied to materials of outdoor insulators and bushings have been conducted. Recently, As nano technologies have been developed, nano fillers are added to electrical materials to improve mechanical and electrical performances. In this paper, Room Temperature Vulcanizing(RTV) silicone rubber nanocomposites was studied about electrical performances and hydrophobicity recovery under the AC electrical stress and contamination. Silica and ATH was added as nano fillers, and specimens was contaminated by a dipping method. Flashover voltage and contact angle was measured. As a result, Nano filler improved electrical performances, and not reduced the hydrophobicity recovery.

NM-WeP3 N-containing ZnO Rods with Tunable Concentration Synthesized by Hydrothermal Method, *Taiki Ihara, K. Katsumata*, Tokyo Institute of Technology, Japan, *T. Watanabe*, Meiji University, Japan, *K. Okada, N. Matsushita*, Tokyo Institute of Technology, Japan

Recent research has shown that N-doping into TiO_2 , Ta_2O_5 , or LaTaO_4 is effective for narrowing the band-gap and attaining the visible-light photocatalysis. N-doped metal oxide powder is commonly synthesized by elevating metal oxide specimens temperature over 500°C with flowing ammonia gas or nitrogen. In this study, we succeeded in synthesizing N-containing ZnO rods by hydrothermal process using ammine-hydroxo zinc complex solution at 100°C.

10 ml of 2.5 M NaOH (aq) was added in drops to 15 ml of 0.5 M $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ aqueous solution over stirring vigorously. The resulting hydroxide

slurry was centrifuged and the supernatant was removed. The hydrated precipitate was dissolved in 50 ml of 6.6 M NH_3 (aq) to form a stock solution. 30 ml of the solution was transferred into a 35 ml Teflon-lined stainless steel autoclave, followed by heating in an oven at 100°C for 6-24 h. After the reaction, the precipitates were separated by centrifugation, and then washed with water.

The diffraction peaks in XRD patterns for synthesized sample was good agreement with those of the hexagonal wurtzite structure of ZnO (JCPDS card 36-1451). The morphology of the ZnO particles were hexagonal rods and the size was about 20 μm in long axis and about 1 μm in diameter. UV-vis spectra for the sample prepared for different reaction time revealed that the absorption band was shifted to visible region as increasing the reaction time. In the raman spectra, typical Ramanactive modes for ZnO (E_2 , $\text{A}_1(\text{TO})$, $\text{A}_1(\text{LO})$, $\text{E}_1(\text{TO})$, and $\text{E}_1(\text{LO})$) were clearly observed for all samples. In addition to the above, new peak was observed at 582 cm^{-1} on N-containing ZnO rod which is attributed to the $\text{E}_2(\text{Zn-N})$ mode. N concentration calculated from XPS data was increased as increasing the reaction time. XPS spectrum of N 1s for the sample prepared at 100°C for 6 h showed the asymmetric broad peak indicating that more than one chemical states of N were present. The binding energy at ~399.0 eV was attributed to the surface species of NH_3 or amines. The another peak at ~397.0 eV was ascribed to N atom in Zn-N bond indicating that N was incorporated in ZnO rods.

NM-WeP4 Synthesis of TiO_2 Monolith Structure Modified Nanotubes, *Ken-ichi Katsumata*, Tokyo Institute of Technology, Japan, *M. Yamamoto*, Tokyo Institute of Technology, *N. Matsushita, K. Okada*, Tokyo Institute of Technology, Japan

TiO_2 is actively studied as photocatalyst with environmental applications effected on photocatalytic performance by adjusting many factors in the structure. Recently, TiO_2 monolith with unique three-dimensional structure has been reported. This is expected to various applications because the pore size and volume are able to control by the synthesis condition. The material, generally used as an adsorbent, extended the applications with visual light-sensitive. In this research, TiO_2 monolith was synthesized with various heating temperatures, and its photocatalytic activity was investigated under visible light.

Porous TiO_2 monolith was synthesized by sol-gel method. HCl, the aqueous solution of Polyethylen glycol (10000) in water and N-methyl formamide are added to Titanium propoxide stirring under ice-cooled condition. The gel is aged at 60°C for 24 h and heat-treated at 200°C for 2 h in stainless-steel autoclave with a Teflon inner liner. The wet gel plate thus obtained is washed by 1-propanol for 12 h, slowly drying for 1 week at room temperature and calcinated at 600, 700, 800 and 900°C for 5 h. Each of temperature rising rates is 1.0 °C/min. Each sample is immersed in the CuCl_2 (molar ratios of $\text{Cu}/\text{TiO}_2 = 1.0 \times 10^{-3}$) aqueous solution at 90°C for 3 h. After washing by water and drying at 80°C, they are measured photocatalytic activity.

The samples heated at 600, 700, and 800°C had monolith structure, and the pore size and primary particle size depend on calcination temperature. However, the sample heated at 900°C did not maintain monolith structure. From the results of XRD patterns and Raman spectra, anatase was main phase at less than 700°C while rutile started to be observed at more than 700°C. It is expected that $\text{Cu}(\text{II})$ -grafted rutile monolith samples exhibit excellent photocatalytic activity under visiblelight. In addition, it was succeeded that rutile nanotubes were formed on the surface of the monolith structures by solvothermal treatment. The monolith with nanotubes had very high specific surface area compared to the monolith without nanotubes. In detail, I will report the activity on the day.

NM-WeP5 Surfactant-Free Solution Phase Synthesis of CuO Nanostructures with Controlled Dimensions, *BG Ganga, P. Santhosh*, Indian Institute of Technology Madras, India

CuO is a versatile p-type transition metal oxide semiconductor with a narrow band gap in the region 1.2-1.8 eV [1]. It is a naturally abundant, nontoxic and stable material and is commonly used as a component material in a wide range of applications such as gas sensing, catalysis and energy storage and conversion [2-4]. Three dimensional ellipsoidal shaped CuO nanostructures and two dimensional nanosheets have been successfully synthesized using surfactant free simple solution phase method. Synthesis of CuO nanostructures was followed by structural, morphological characterization using X-ray diffraction, Scanning Electron Microscopy and Transmission Electron Microscopy. We have demonstrated that morphology and dimensionality of nanostructures can be controlled by changing the initial reactant concentrations. It is observed that ordered aggregation and growth of smaller CuO subunits generates an ellipsoidal

shaped morphology at lower reactant concentration, while at higher reactant concentration, sheet like structures are generated. Self-assembled structures provide an opportunity to investigate the formation mechanism and aggregation based growth of nano subunits as fundamental building blocks. This bottom-up method offers facile synthesis of nanostructures of controlled morphology and functionality. We have also observed a change in morphology as the nanostructures were thermally annealed. A morphological transformation from rod-like to plate-like structure was observed as the flake-like nanostructures were annealed at 400°C and 600°C respectively. The formation mechanism that plays behind the generation of different CuO nanostructures is explored. Optical properties are investigated using UV-Vis spectroscopy and Raman spectroscopy. We found that morphology of the nanostructure strongly reflect on the optical properties as band gap widening and the change in the position and width of Raman modes.

References

- [1] M.A. Gondal, T.F. Qahtan, M.A. Dastageer, T.A. Saleh, Y.W. Maganda, D.H. Anjum, *Appl. Surf. Sci.* 286 (2013) 149.
- [2] Z. Zhang, H. Che, Y. Wang, L. Song, Z. Zhong, F. Su, *Catal. Sci. Technol.* 2 (2012) 1953.
- [3] M. Frietsch, F. Zudock, J. Goschnick, M. Bruns, *Sens. Actuat. B* 65 (2000) 379.
- [4] X.P. Gao, J.L. Bao, G.L. Pan, H.Y. Zhu, P.X. Huang, F. Wu, D.Y. Song, *J. Phys. Chem. B* 108 (2004) 5547.

NM-WeP16 Nanocrystalline Diamond Powder Fabricated using Coaxial Arc Plasma Equipped with Chromium-Blended Graphite Targets, Aki Tominaga, H. Naragino, Kyushu University, Japan, D. Deguchi, Kyushu Institute of Technology, Japan, K. Takeda, Fukuoka Institute of Technology, Japan, T. Yoshitake, Kyushu University, Japan

Nano-sized diamond, such as nanocrystalline diamond (NCD), ultrananocrystalline diamond (UNCD), and diamondoids, is a new nanocarbon. Since it was reported that diamond exhibits strong photoluminescence due to nitrogen-vacancy center and generates defect-induced magnetization, the application of nanodiamonds to drug delivery has received much attention. In order to induce the novel functionalities in diamond, doping should be carried out precisely.

Nano-sized diamond powder has ever been fabricated by detonation, and the doping of foreign elements to the powder has been made mainly by ion implantation. In-situ doping during the formation should enable us to incorporate foreign element atoms into nano-sized diamond, effectively and simply. In this work, we employed a coaxial arc plasma gun for the formation of UNCD powder and demonstrated the in-situ doping of chromium during the formation. A coaxial arc plasma gun (ULVAC APG-1000) equipped with a chromium-blended graphite target was operated in vacuum and hydrogen atmospheres. The head of the gun was pointed at a quartz plate. The distance between the plate and gun head was 15 mm. Quartz plate's temperatures are 550 °C. Films that quickly and automatically exfoliated from the plate were gathered, and they were smashed into powder. The XRD pattern of 10 at% Cr doped powdered diamond nanoparticles, measured with 12 keV X-ray at beamline 15 of the SAGA-LS, exhibited obvious peaks due to diamond-111 and 220. The electron diffraction also exhibited the similar results. Chromium K-edge XAFS spectra were measured at beamline 6 of the SAGA-LS (Kyushu University Beamline). The magnetic properties were measured by a vibrating sample magnetometer and superconducting quantum interference device. The details will be reported in the conference presentation.

This work was partially supported by JSPS KAKENHI Grant Number 26790019, Kazuchika Okura Foundation, and JGC-S scholarship foundation. The experiment using synchrotron radiation were performed at the beamline BL15 of the SAGA Light Source with the approval of the Kyushu Synchrotron Light Research Center (Proposal No. 1303019A). XAFS measurements were performed at Kyushu University Beamline (SAGA-LS/BL06).

NM-WeP18 Effect of Heat Treatment on the Damping Capacity and Texture of Magnesium Alloy, Jongyoung Lee, College of Engineering, Pukyong National University, Republic of Korea, H. Kwon, Pukyong National University, Republic of Korea, J. Choi, College of Engineering, Pukyong National University, Republic of Korea, K. Kim, Pukyong National University, Republic of Korea

Much attention has been paid on Magnesium alloys in electronics and automobiles industrial parts, due to lightweight and other excellent properties, such as low density, high specific strength, and good castability. However, due to the limited number of slip systems associated with their hexagonal close-packed crystal structure, both magnesium and its alloys show poor room-temperature formability. It is well-known that crystallographic texture plays an important role in both plastic deformation

and macroscopic anisotropy of magnesium alloys. Therefore, many authors have been studied to understand the texture control of magnesium alloys, focusing on improvement of the room temperature formability in Magnesium alloy. However, despite having many excellent properties in magnesium alloys, the study for various properties of magnesium alloys have not been clarified enough.

It was well-known that magnesium alloys have a good damping capacity compared to the other alloys. Also, the damping properties of metals are generally recognized to be dependent on microstructural factors such as grain size and texture. However, there are very few studies on the relationship between the damping ability and texture of Mg alloys. Therefore, in this study, the AZ31 magnesium alloy which was carried out by heat treatment was experimentally investigated about the relationship between the texture and damping capacity.

A 60 mm × 60 mm × 40 mm rectangular plate was cut out by machining an ingot of AZ31 magnesium alloy (Mg-3Al-1Zn in mass%), and rolling was carried out at 673 K to a rolling reduction of 30%. Then, heat treatment was carried out at temperatures in the range of 573–723 K for durations in the range of 30–180 min. The samples were immediately quenched in oil after heat treatment to prevent any change in the microstructure. Specimens for damping capacity measurements were machined from the rolled specimen, to have a length of 120 mm, width of 20 mm, and thickness of 1 mm. The damping capacity was measured with a flexural internal friction measurement machine at room temperature. Texture was evaluated on the compression planes by the Schulz reflection method using nickel-filtered Cu K α radiation. Electron backscatter diffraction measurements were conducted to observe the spatial distribution of various orientations. It was found that the damping capacity increases with both increasing heat-treatment temperature and time, due to grain growth and also, the pole densities of texture increase with increasing the internal friction.

NM-WeP20 Total Analysis of Silica Nanotube Surface by using TOF-SIMS, Jong Sung Jin, Kim, Kim, Jeong, Kahn, Korea Basic Science Institute, Korea, Lee, Jin, Korea Institute of Industrial Technology, Korea

Recently, many researchers have been interested in the self-assembled 3D supramolecular structures to synthesis of helical silica nanotubes. We have been studied the solvent-effects on the synthesizing of helical silica nanotubes via polycondensation of tetraethoxysilane (TEOS) on self-assembled structures that were composed 1,2-diphenylethylenediamine based neutral (G1) and cationic (G1N) gelators.[1] In this study, we analyzed helical silica nanotubes and derivatized chiral stationary phases by using TOF-SIMS. We discussed products of each steps for the derivatized organic compound on the silica surface in order to confirm the reactions.

[1] T. K. Kim, E. D. Jeong, C. Y. Oh, M. H. Hyun, M. S. Lee, H. K. Moon, J. P. Kim, O. S. Jung, F. N. Nawaz, J. S. Jin, *Chem. Pap.* 65(4), 2011, 495

NM-WeP21 Photodetector and Pressure Sensor Based on Field-Effect Transistor with the Nanohybrid Channel of ZnO Nanorods and Graphene, Dang Vinh Quang, T.Q. Trung, D.-I. Kim, L.T. Duy, B.-Y. Kim, B.-U. Hwang, D.-W. Lee, N.-E. Lee, Sungkyunkwan University, Korea

Field-effect transistors (FETs) with a nano-hybrid channel of chemical-vapor-deposited graphene (CVD Gr) and vertically aligned ZnO nanostructures are successfully fabricated and operated at low voltage. By the combination of highly conductive Gr and the high UV absorption of ZnO, ultraviolet (UV) photodetectors are investigated under illumination at various incident photon intensities and wavelengths. The change in the transfer characteristics of hybrid-channel FETs under UV light illumination allows to detect both photovoltage and photocurrent. The shift of the Dirac point (V_{Dirac}) observed during UV exposure led to a clearer explanation of the response mechanism and carrier transport properties of Gr, and this phenomenon permits the calculation of electron concentration per UV power density transferred from ZnO nanorods (NRs) and ZnO nanoparticles (NPs) to Gr, which is 9×10^{10} and 4×10^{10} per mW, respectively. The time-dependent behaviours of hybrid-channel FETs exhibit high UV responsivity (RI) and high photoconductive gain (G). The maximum values of RI and G infer from the fitted curves of RI and G versus UV intensity are 3×10^5 A W $^{-1}$ and 10^6 , respectively. More interestingly, due to the piezoelectric property of ZnO, a piezoelectric-coupled hybrid channel GFET can be used as a pressure-sensing device with high responsiveness and a fast response time. The shifts of V_{Dirac} under mechanical pressurization are analysed to explain clearer the charge transferred mechanism with electron transfer of 4×10^8 cm $^{-2}$ kPa $^{-1}$ from the CVD Gr to ZnO NRs. Therefore, hybridization of semiconductor 1D nanomaterials with Gr channel in FET structures resulting in high performance and low power consumption opens up new opportunities for future optoelectronic devices.

Suggested topic: Nanomaterials (NM1-Nano Devices)

NM-WeP22 Defect Induced Visible Light Photocatalytic Activity of SnO₂ Nanoparticles, Sajid A. Ansari, M.M. Khan, M.O. Ansari, Cho, Yeungnam University, South Korea

We report the defect-induced band gap narrowing of pure SnO₂ nanoparticles (p-SnO₂) using an electrochemically active biofilm. The proposed approach is biogenic, simple and green. The systematic characterization results of the modified SnO₂ nanoparticles (m-SnO₂) revealed EAB-mediated defects in p-SnO₂. m-SnO₂ nanoparticles in visible light showed the enhanced photocatalytic degradation of p-nitrophenol and methylene blue compared to p-SnO₂ nanoparticles. Photoelectrochemical studies, such as electrochemical impedance spectroscopy and linear scan voltammetry, also revealed a significant increase in the visible light response of m-SnO₂ compared to p-SnO₂ nanoparticles. The enhanced activities of m-SnO₂ in visible light was attributed to the high separation efficiency of the photoinduced electron-hole pairs due to surface defects created by EAB, resulting in band gap narrowing of the m-SnO₂ nanoparticles.

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