DS 6: Thin Film Applications II

Time: Monday 10:45–12:00 Location: CHE 91

DS 6.1 Mon 10:45 CHE 91

Konforme Einbettung hocheffizienter Spektrometergitter mittels Atomlagenabscheidung — •Kristin Pfeiffer[1], Vivek Beladiya[1,2], Torsten Harzendorf[1], Thomas Flügel-Paul[1], Dirk Michaelis[1] und Adriana Szeghalmi[1,2] — [1]Fraunhofer-Institut für Angewandte Optik und Feinmechanik, Albert-Einstein-Str. 7, 07745 Jena — [2]Friedrich-Schiller-Universität Jena, Institut für Angewandte Physik, Albert-Einstein-Str. 15, 07745 Jena

Hocheffiziente Beugungsgitter, welche als dispersive Kernkomponenten in Spektrometern zum Einsatz kommen, stellen höchste Anforderungen an die Empfindlichkeit und Auflösung der optischen Gitter. Im vorliegenden Fall wird ein Spektrometergitter für das SWIR2-Band untersucht. Die wesentliche Herausforderung liegt hierbei in einer nahezu polarisationsunabhängigen Beugungseffizienz von mehr als 80 %.

Das betrachtete optische Design kombiniert ein Grundgitter aus Kieselglas (SiO2) mit einer hochbrechenden Einbettung aus TiO2. Das TiO2-Material wird hierzu konform mittels plasmagestützter Atomlagenabscheidung (PEALD) aufgebracht. Der PEALD-Prozess ist ein zentraler Aspekt in der Realisierung des Spektrometergitters, da sowohl die optische Qualität als auch die Konformität des eingebetteten Materials einen wesentlichen Einfluss auf die optische Effizienz des Gitters haben. Im Tagungsbeitrag wird im Speziellen der Einfluss der PEALD-Prozessparameter auf die Einbettung des Gitters und dessen Transmissionseffizienz für TM- bzw. TE-polarisiertes Licht betrachtet.

DS 6.2 Mon 11:00 CHE 91

Large area plasmonic sensor for refractive index based on partial-circular pair arrays — •Fanzhou Lv, Jiaxu Chen, Yudie Huang, Shiyao Jia, Zhihang Wang, Yi Wang, and Wenxin Wang — Harbin Engineering University, No. 145 Nantong Str, Nangang District, Harbin, China

Plasmonics is a rapidly developing branch in nanophotonics that embodies the feature of generating exceptional optical field enhancements in nanometer volumes. As a result of that, a considerable amount of high sensitivity sensors are attempting to construct based on localized surface plasmon resonance (LSPR). Here, a large area nanoarrays consist of partial-circular pairs is proposed as an example for refractive index sensing. First, the large area sample is fabricated by utilizing artificial alumina membranes with tetragonal lattice in physical vapor deposition (PVD) process and easy to implement to application. In addition, angle-resolved photonic spectroscopy is used to characterize the optical property variation of partial-circular pair (PCP) arrays as function of incident angle in the range of visible light. On one hand, for the symmetry-split nanoarray, a low-quality dipolar resonance is witnessed at normal incidence. On the other hand, after breaking the symmetry of unit in nanoarray, a strong Fano-like resonance is generated with high-quality factor. Besides, a pronounce coupling- induced reflection peak is observed within a broad spectral range, which is beneficial for improving the sensitivity of the refractive index sensor. In short, the optical phenomenon from symmetry breaking inspired us to optimize the designed PCP array as a refractive-index sensor.

DS 6.3 Mon 11:15 CHE 91

Novel Ion Detector with High Sensitivity for Multi-Ion Sensing — •Kun-Lin Liou, Ying-Chun Shen, Chien-Ping Wang, Yu-Lun Chueh, Chrong Jung Lin, and Ya-Chin King — National Tsing-Hua University 101, Sec. 2, Kuang-Fu Road, Hsinchu 30013, Taiwan, R. O. C

Nowadays, the ion sensor plays an important role in our daily lives. From pH level, heavy metal monitoring and evaluating bio-medical ion balance, these applications become more accessible as sensing technologies matures. The ion sensitive FET has compact size, cost-effective and fast response time; however, it is limited by the Nernst limit. The proposal ion detector with coupling structure not only can achieve high sensitivity, its sensing range can also be dynamically adjusted by setting suitable biasing conditions to alleviate such a challenge. Here, we especially focused on comparing the effect of various kinds of sensing film, their corresponding thickness and sensing region size on the sensing characteristics of the new detector. This new detector can deliver an output responsivity as high as 150 mV/pH. Moreover, the preliminary measurement results on sodium ion sensing obtained by calix[4]arene film are demonstrated. With a sensing gate isolated from the transistor channel, the proposal sensor has fully sensing capability to other kinds of ion such as heavy metal ion and so on. It also suggests that the proposed device can be integrated into sensors array for the detection of multiple ions simultaneously. Further optimization of coating material in the sensing membrane is expected to enhanced the performance of this new ion detector.

DS 6.4 Mon 11:30 CHE 91

Synthesis of Rutile-TiO_2 Nanorod Arrays for Efficient Solar Water Splitting via Microwave-Assisted Hydrothermal method — •Amin Qasim — University of Zakho,Duhok,KRG-Iraq

Using a microwave-assisted hydro thermal method (MWAHM) a single crystalline of vertically aligned TiO_2 nanorod (NR) arrays has been demonstrated via the novel ultra-rapid synthetic method for the production. High-quality NR arrays with controlled film thickness were achieved with fine control of the growth conditions as well. The effect of the different reaction conditions of MWAHM such as reaction time and growth temperature on the morphology, crystal orientation, and photo catalytic activity have been systematically investigated. In a typical condition of the MWAHM using 0.4 cm3 of titanium(IV) n-butoxide (TBO) at 180°C for 40 minutes, a small diameter and short length 124 nm and 2.93 m of TiO_2 nanorods respectively, are grown on fluorine-doped tin oxide (FTO) substrate. However, the photo current density produced TiO_2 NRs of 2.90 mA cm-2 with a maximum photo conversion efficiency of about 2.7 % which confers excellent photoelectrochemical performance. In comparison with the typical hydro thermal method (HM) synthesized NRs, the ultra-fast MWAHM synthesized NRs offers five times more efficiency photoelectrochemical (PEC) water splitting than the hydro thermal method (HM). The results suggest that these dense and aligned one-dimensional TiO_2 nanorods are promising for hydrogen generation from water splitting based on PEC cells.

DS 6.5 Mon 11:45 CHE 91

Sputter deposition of tungsten oxide and study of its electrochromic behavior for various electrolytes — •Mario Gies, Martin Becker, Fabian Michel, and Angelika Polity — Institute of Exp. Physics I and Center for Materials Research (LaMa), Justus Liebig University Giessen, Germany.

In this work, tungsten oxide films were prepared by means of various types of the sputter deposition, i.e. ion-beam and radio-frequency (rf)-sputter deposition. The focus was on optimizing the layers especially for use as a component in an electrochromic device. Layers were deposited from a metallic tungsten target under various gas mixtures of argon, oxygen and additional hydrogen. The choice of different gas mixtures allows to tune the optical characteristics of the synthesized films. Glass coated with fluorine-doped tin oxide (FTO) was used as substrate in order to establish an electrical contact for electrochemical measurements. The as-grown rf-sputtered layers were found to be amorphous. Ion-beam sputtered films were deposited under ambient as well as elevated growth temperatures. As a consequence, in addition to amorphous samples, crystalline films were grown. The different layers were investigated on the basis of their structural and compositional characteristics. Finally, the electrochromic properties of selected samples were examined in electrochemical measurements using different electrolytes.