First Discovery of Tetravalent Ti Ion Conduction in a Solid

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We have succeeded in developing a pure tetravalent Ti4+ ion conducting solid by designing the constituents of NASICON-type solid, TiNb(PO4)3. Although titanium cation has two kinds of valences of +3 and +4, implying the appearance of electronic conduction caused by the valence change, we have clarified that the Ti(Nb0.8 W0.2 )5.0/5.2 (PO4)3 solid in which the Nb5+ site was partially replaced by tetravalent W4+ ion was a pure Ti4+ ion conductor without showing any electronic conduction. The present study explicitly indicates that such a cation having multi valence state can be also a promising candidate for migrating ion species in solids by strictly selecting the crystal structure and its constituent ion species.

Chemistry of Materials, 21, 579-581 (2009)

170-MHz Electrodeless Quartz Crystal Microbalance Biosensor: Capability and Limitation of Higher Frequency Measurement

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We develop a highly sensitive quartz crystal microbalance (QCM) biosensor with a fundamental resonance frequency of 170 MHz. Its shear vibration is excited by the line wire, and the vibration signals are detected by the other line wire, achieving the noncontacting measurement of the resonance frequency. The mass sensitivity of the newly developed biosensor is better than that of a conventional QCM biosensor by three orders of magnitude. Its high sensitivity is demonstrated by detecting human immunoglobulin G via staphylococcus protein A immobilized nonspecifically on both surfaces of the quartz plate. The detection limit is 0.5 pM.

Proceedings of the IEEE, 107(11), 2009-2011 (2009)

Bacterial artificial chromosome library for genome-wide analysis of Chinese hamster ovary cells

Omasa, T., Cao, Y., Park, J.Y., Takagi, Y., Kimura, S., Yano, H., Honda, K., Asakawa, S., Shimizu, N., Ohtake, H. (Graduate School of Engineering)

Chinese hamster ovary (CHO) cell lines are widely used for scientific research and biotechnology. A CHO genomic bacterial artificial chromosome (BAC) library was constructed from gene-amplified CHO DR1000L-4N cell line for genome-wide analysis of CHO cell lines. The library consisted of 122,281 clones and was expected to cover the entire CHO genome (approximately same size of human genome) five times. One CHO BAC library has the potential to contribute to next generation cell engineering on the basis of our understanding of chromosomal organization during the establishment of recombinant CHO cell lines.

Biotechnology and Bioengineering, 104, 986-994 (2009)

Electrolyte-Gated Graphene Field-Effect Transistors for Detecting pH and Protein Adsorption

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Graphene, single layer of two-dimensional hexagonal network of carbon atoms, have been intensively studied in recent years due to their extremely high carrier mobility (>20,000 cm2/Vs at room temperature). We investigated electrolyte-gated graphene field-effect transistors (G-FETs) for electrical detecting pH and protein adsorptions. G-FETs immersed in an electrolyte showed transconductances 30 times higher than those in a vacuum and their conductances exhibited a direct linear increase with electrolyte pH, indicating their potential for use in pH sensor applications. We also attempted to detect surface-protein adsorption and showed that the conductance of G-FETs increased with exposure to a protein at several hundred pM.

Nano Letters, 9, 3318-3322 (2009)

Dynamic reconfiguration of the network topology is one efficient way to accommodate traffic that changes unpredictably. To reconfigure the network, traffic matrices, which indicates traffic volumes between all pairs of edge nodes, is required. However, it is difficult to monitor traffic matrices directly. This paper proposes a network reconfiguration method which cooperates with the estimation of traffic matrices. In this method, topology reconfiguration is divided into multiple stages. In each stage, we reconfigure the topology by using the estimated traffic matrix. Then, by using the link loads after the reconfiguration, we calibrate and reduce the estimation errors of traffic matrices. By continuing the above steps, we can reduce estimation errors significantly and reconfigure the sufficient network topology at the end.

IEEE/ACM Transactions on Networking, 18, 177-189 (2010)

This paper describes the application of organic light-emitting diodes (OLEDs) and organic photodetectors (OPDs) to integrated photonic devices for the realization of all polymeric local area network (LAN). The fabrication and characteristics of OLEDs and OPDs fabricated by vacuum and solution processes were reported. 100 MHz signals have been created by directly driving of OLEDs and 80 MHz signals have been received by OPDs. Clear video signals have been transmitted using vacuum and solution processed OLEDs, and successfully received by the OPDs. This study ascertained that organic devices are applicable to integrated photonic devices for optical local networks.

Proceedings of the IEEE, 97, 1627-1636 (2009)

Development and experimental verification of a genome-scale metabolic model for Corynebacterium glutamicum

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This paper presents the reconstruction of a genome-scale metabolic model of C. glutamicum, containing 502 reactions and 423 metabolites, for in silico simulation of metabolic flux profiles. Using this model, we simulated the changes in the metabolic flux profiles that occur on changing the oxygen uptake rate, and found that the predicted metabolic fluxes agreed well with the experimental data. The genome-scale metabolic model provides useful information for the evaluation of the metabolic capabilities and prediction of the metabolic characteristics of C. glutamicum, which can be used for the basis for the rational design of the metabolic networks of this microorganism for bioproduction.

Microbial Cell Factories, 8, 41 (2009)

A simple copolymer, poly(NIPAM-co-Sp), consisting of N-isopropylacrylamide (NIPAM) and spiropyran (SP) units, was synthesized. The copolymer, when dissolved in water, behaves as a colorimetric thermometer that exhibits a linear and reversible bathochromic and hypochromic shift of the absorption spectra associated with the change in temperature under UV irradiation. The color change of the polymer is driven by a temperature-induced phase transition of the polymer from coil to globate state. The polarity change of the inner polymer environment associated with this phase transition promotes the isomerization of the photofomed merocyanine fragment, resulting in an color change of the polymer.

Organic Letters, 11, 1571-1574 (2009)