ABSTRACTS OF PUBLISHED PAPERS

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CONDENSED MATTER AND MATERIAL

Cluster Ion Bombardment on Atomically Flat Au(111) Solid Surfaces

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Energetic cluster ion bombardment shows unique and complicated interactions between constituents of the cluster and atoms of the target surface. STM observation is one of the most powerful methods to investigate the cluster ion - solid surface interaction. We have observed crater-shape traces on HOPG surface bombarded by energetic Ar cluster ions. However, STM images of HOPG surfaces are influenced by special electronic surface states. In this paper, Ar monomer and cluster ions are bombarded on Au(111) surfaces on mica to observe ion traces by STM. In addition, the relationship between the parameters of cluster ion beams and the features of ion traces are discussed. The STM observation showed that Ar cluster ion bombardment had circular crater-like shapes, and the diameter of them were proportional to the cubic root of ion energy. These indicate that the kinetic energy of cluster ions is deposited on the surface isotropically.

Photon-Energy Dependence of Light-Induced ESR for Poly(para-phenylene vinylene) and Its Derivatives

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Synthetic Metals **91** (1997) 359-362

To study the nature of photoexcitation in poly (paraphenylene vinylene) (PPV), we have performed a combined study of light-induced ESR (LESR) and photo-luminescence (PL). The LESR signal increases with increasing the incident photon-energy and it becomes significant above 3.1 eV for PPV and 2.7 eV for CH_3O-PPV, respectively. The observed absorption and PL peaks of poly(2,5-dimethoxy-para-phenylene vinylene) (CH_3O-PPV) are slightly lower than those of PPV, corresponding to a smaller band-gap. The results are consistent with the LESR action spectra. We also measured the polarized-LESR for stretch-oriented PPV. The LESR signal being excited at 340 nm (3.7 eV) is larger for polarized light perpendicular to the chain direction than for the parallel case, suggesting that interchain charge separation is important for the LESR.

Electrical Properties of B-Doped Homoepitaxial Diamond (001) Film

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Diamond and Related Materials **6** (1997) 1753-1758

Relationship between growth condition and quality of homoepitaxially grown B-doped diamond (001) film has been studied using physical measurements of defect density as a function of doping concentration. In particular, electrical properties of the homoepitaxial diamond film were characterized using measurements of conductivity, carrier concentration and mobility. The highest mobility is found to be about $1000 cm^2V^{-1}s^{-1}$ at 293 K, indicating that the quality of the CVD diamond film is further improved through optimizing the growth condition. The density of the

compensation donor was determined from the temperature-dependent hole concentration. The lowest donor density is found to be $8.4 \times 10^{15} cm^{-3}$ in the present work. This is an order of magnitude greater than the lowest value measured in natural IIb diamond. Furthermore, it is also found that the donor density increases with increasing doping concentration during the growth. On the other hand, the mobility decreases rapidly with increasing doping concentration. From these result, we speculate that the compensation donor is an origin of an additional scattering center in diamond, and excessive B-doping makes the quality of the CVD diamond worse.

Ultrafast Magnetic Dynamical Phenomena Observed by Optical Methods

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OPTRONICS **3** (1998) 138-143

Recent development of ultrafast magnetic spin orientation and reorientation phenomena observed and controlled by means of ultrashort pulse lasers is reviewed. The dynamical spin spectroscopies applied to the low dimentional diluted magnetic semiconductors are demonstrated.

Diamond Films Epitaxially Grown by Step-Flow Mode

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J. OF CRYSTAL GROWTH **183** (1998) 338-346

Homoepitaxial diamond films were grown by the step-flow mode.The obtained films grown by this mode were characterized using atomic force microscopy, reflection high-energy electron diffraction (RHEED), cathodoluminescence (CL), and junction properties of Al-Schottky contacts. It is found that the surfaces of the films are coverd with macroscopic steps running parallel to the [110] direction.The narrow and streaky RHEED patterns show the surfaces of the films are flat with 2×1 and 1×2 double-domain structure. From the CL spectra, strong excitionic luminescence is clearly observed in the temperature range between 120 and 300 K. The absence of the band-A emission in the CL spectra suggests a low density of dislocation in the films. The current -voltage characteristics of Al-Schottky contacts on the as-deposited diamond films show excellemt junction properties with the ideality factor of 1.1. These results indicate immense potential for diamond as a semiconducting material.

Hydrogen-Related Gap States in the near Surface of Chemical Vapor Deposited Homoepitaxial Diamond Films

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Diamond and Related Materials **6** (1997) 303-307

We have investigated electrical and optical properties of high-conductivity layers existing in the near surface of as-deposited (hydrogenated) homoepitaxial diamond films. It is found from Hall effect measurements that both hydrogenated undoped and B-doped diamon films have a high concentration of holes (~ $10^{12} cm^{-2}$ at 297K), while the conventional oxidized B-doped films have a much lower concentration of holes (~ $10^{8} cm^{-2}$ at 297K) which corresponds to that of doped B-atoms. The temperature dependence of the forward *I-V* characteristics of the Al-Schottky barrier to the high-conductivity layers indicates the existence of high-density gap states which act as acceptors in the layer. As for the cathodoluminescence study, a broad luminescence peak at around 540 nm is observed in the near surface of hydrogenated films,but not in oxidized films. These experimental results suggest that hydrogen-related gap states due to the hydrogen incorporation exist in the near surface of the hydrogenated diamond films, some of which act as shallower acceptors causing the high conductivity.

Long-Range Excitons in Conjugated Polymers with Ring Torsions

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CHEMICAL PHYSICS LETTERS **281** (1997) 319-324

Ring torsion effects on optical excitation properties in poly(para-phenylene) (PPP) and polyaniline (PAN) are investigated by the intermediate exciton formalism. Long-range excitons are characterized, and the long-range component of the oscillator strengths is calculated.We find that ring torsions affect the long-range excitons in PAN more easily than in PPP, due to the larger torsion angle of PAN and the large number of bonds whose hopping integrals are modulated by torsions.

INFORMATION SCIENCE

Recognition of 3D Free-Form Objects Using Segment-Based Stereo Vision

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The Transactions of the Institute of Electronics, Information and Communication Engineers D-II
J81-D-II 2 (1998) 285-292

We propose a new method to recognize 3D free-form objects from their apparent boundaries. Object models are compared with 3D boundaries which are extracted by a segment-based stereo vision. Based on the local shapes of the boundaries, the candidate transformations are generated. The candidates are verified and adjusted based on the whole shapes of boundaries. The models are built from all-around range data of the objects. Experimental results show the effectiveness of the method.

Simplification of Space-Variant Parallel Logic Operations by Using the Temporal Method

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OPTICAL REVIEW **4** 2 (1997) 305

A time-domain encoding method (temporal method) for space-variant parallel logic operations, which can execute different operations in parallel, is proposed. The temporal method is based on temporal encoding of two input patterns, temporal gating of the coded pattern, and decoding by temporal addition of the gated patterns. The first feature of the proposed method is that parallel logic operations can be performed without complex pattern transformations. The second feature is that the logical output can be directly fed to succeeding systems without specific decoding. Therefore, the logic operation system can be constructed using conventional optics and existing spatial light modulators. In order to confirm these features, an optoelectronic experimental system is constructed and space-variant parallel logic operations are performed.

Optical Learning Neural Network with Two Dimensional Structure for Pattern Recognition

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OPTICAL MEMORY AND NEURAL NETWORKS
6 3 (1997) 205

We constructed an optoelectronic learning neural network system based on two-dimensional structure. The system is composed of multiple imaging optics with a Selfoc microlens array, a liquid crystal spatial light modulator and a computer. The system achieves a large-scale input-hidden layer network in the optical system and does a small-scale hidden-output layer network on the computer. It is difficult and cost for the optical alignment of the liquid crystal devices that display the weight tensors and for the calculation of the learning signals in the input-hidden layer network. To solve these problems, we applied random search algorithm with the optical system. On the hidden-output layer network, effective learning was advanced by using generalized delta rule in the computer. The compound system succeeded in learning of seven typed alphabetic characters that directly detected with a CCD camera.

BIOSCIENCE

Two Olfactory Centers in the Human Brain Detected by MEG

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BRAIN TOPOGRAPHY TODAY
International Congress Series **1147**
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We measured neuromagnetic responses using a 122-channel whole-head neuromagnetometer and a new type of odorant stimulator in 6 healthy adults, then the olfactory activated centers were estimated. Odorant pulses were delivered into the nostril via a ventilation mask and non-magnetic air pressure valves with the subject in a magnetically shielded room. The odorant gas used was amylacetate (banana-like odor). The main equivalent current dipole was dominantly located in the orbito-frontal region on the ipsilateral side after either left or right nostril stimulation. Using the two-dipole method, we detected two olfactory centers in the deep bilateral frontal areas. These two olfactory centers were distinguished from the somatosensory regions activated by the trigeminal response to air stimulation.

Brain topography study of aromacological relaxation using EEG and MEG

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BRAIN TOPOGRAPHY TODAY
International Congress Series **1147**
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We measured the state of "relaxation-alertness" in humans by brain topographical mapping using electroencephalography (EEG) and magnetoencephalography(MEG). Studies were conducted on advanced practitioners of the self-regulation method(modified from Autogenetic Training by Y.Ikemi), transcendental meditation, Kikou meditation and aromacological stimulation. Sixteen EEG eledtrodes were set on the scalp according to the international 10-20 method. Relative EEG power was calculated for the δ , θ , α , and β bands. During meditation the brain was activated synchrnously over all frequency bands. Activation was significantly increased by the inhalation of fragrances. Topographical mapping of EEG data showed that fragrance inhalation activated the frontal area, while MEG experiments showed a bilateral responses in the frontal regions.

Activation of the Auditory Cortex by Ultrasound

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The Lancet **351** 9101 (1998) 496-497

There has been no report on the central mechanism of ultrasonic perception, that is which sensory area in the brain is activated by ultrasonic stimulation. Whether or not ultrasound modulated by different speech sounds can be discriminated is also important, considering the possibility of using ultrasonic hearing aids as an alternative to cochlear implants for the profoundly hearing-impaired who can sense only ultrasound. We have used MEG to deternmine which part of the brain is activated by ultrasound, the auditory area receiving ultrasound as a sound sensation, the somatosensory area processing it as a vibro-tactile sensation, or areas specific to ultrasonic processing(exp.1). We have also studied the discrimination capability of ultrasound modulated by different sounds(exp.2).

OPTICS AND RADIATION

Wideband Phase Noise Measurement of Mode-Locked Laser Pulses by a Demodulation Technique

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Optics Letters **23** 4 (1998) 286-288

A new method is proposed and demonstrated for measuring the phase noise (pulse timing fluctuations) of mode-locked lasers. The instantaneous phase of the pulse intensity are extracted in a time domain and the phase noise power spectral density is calculated from the demodulated signals. Compared with the conventional method based on the single sideband phase noise measurement, the proposed method has a larger dynamic range and a wider frequency span. The phase noise of a mode-locked Cr:LiSAF laser is measured for 50mHz-1MHz Fourie frequency.

Observing Molecular Dynamics with Timed Coulomb Explosion Imaging

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Phil. Trans. R. Soc. Lond. A **356** (1998) 329-344

The Coulomb explosion method for imaging molecular structure is combined with the femtosecond pump-probe technique. Thus the imaging method becomes flexible enough to determine molecular structure even in highly excited or transient states as a function of time. Examples for the applicability of this method are given. The major concerns which could limit the reliability and the accuracy of the information extracted are discussed and solutions proposed. In addition to observing time-dependent structures, optically triggered Coulomb explosion imaging can be used to identify unusual events in an ensemble of common but more frequent events.

MEASUREMENT TECHNOLOGY

Radiation Effects in Superconducting-Tunnel-Junction X-ray Detectors

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Nucl. Instrum. Methods Phys. Res. A
399 NOS.2,3 (1997) 343-346

Niobium superconducting-tunnel-junction x-ray detectors were irradiated by high-energy protons typical of those found in space. Deterioration of the energy resolution was observed together with an increase of the leakage current and a nonuniform charge collection due to local regions having a reduced superconducting-energy-gap in niobium electrodes. These two changes are analogous with those in semiconductor detectors, although the detection principles are different.