



The Japan Society for Precision Engineering

Introduction of JSPE Best Paper Awards 2014

1. Study on Polishing Mechanism of Single Crystal Substrate by UV-Excitation

Mutsumi TOUGE, Takugi NAGANO, Tomohiko TAGAWA, Takeshi SAKAMOTO, Hiroyuki YOKOI, Chihiro IWAMOTO and Junji WATANABE

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Diamond has superior characteristics such as the highest thermal conductivity and dielectric breakdown field, and is expected to be a good candidate material for the next generation semiconductor device. On the other hand, the etching and the mechanical processing are much difficult because of chemical and physical stabilities of diamond. As the device materials must be polished without the crystallographic distortion beneath a polished substrate, the simplified planarization techniques accompanied with high surface quality is intensely required. The ultraviolet rays excited polishing of single crystal diamond substrates has been studied in our laboratory. The UV-polishing characteristics, such as higher polishing rate and superior final surface roughness, have been revealed in these many years. This work will interpret the UV-polishing mechanism to achieve a well-polished diamond substrate satisfied for the requirement of the semiconductor device materials. The effects of the ultraviolet irradiation and processing atmosphere on the polishing rate and surface integrities were carefully examined. The polishing mechanism was discussed using experimental results of the luminous phenomenon, CO gas concentration and TEM observation of abrasion powder. The polishing model based on these discussions was proposed, and high-grade diamond wafer was finally obtained by the UV-polishing under the polishing conditions decided by the proposed polishing model.

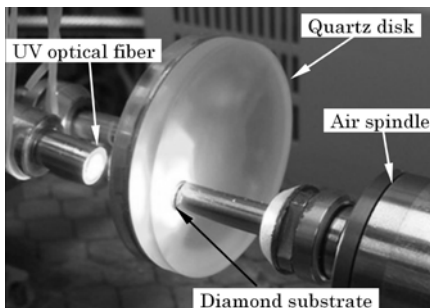


Fig.1 Experimental setup of UV-polishing machine

2. Analytical Study on Response Characteristics of Optical Instruments for Measuring Surface Texture

Akihiro FUJII, Shinichi HAYASHI, Shintaro FUJII, Tomotake TERASAWA and Kazuhisa YANAGI

J. JSPE, Vol.80 No.9 pp.851-855

This paper deals with design concept of physical measurement standards for optical surface measuring instruments. Using the finite-difference time-domain (FDTD) method, a new simulation tool was developed to analyze optical scattering phenomena on a fundamental laser scanning microscope and to investigate the measured results for inclined plane and sinusoidal, rectangular and triangular cross-section surfaces. Some reasons for outlier inclusion in the measurement results were also made clear. Guidelines for designing the standard surfaces were proposed from a viewpoint of their local geometry within a focused beam spot of the instrument under test.

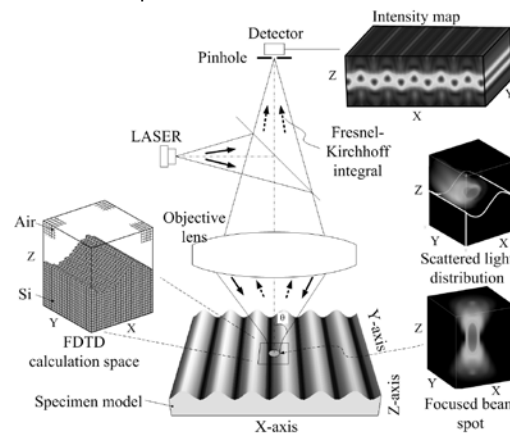


Fig.2 Illustration of analytical model

3. Bullet Identification Based on Feature Enhancement and Local Matching of Striated Toolmarks by Image Analysis

Keigo YONEDA, Shun'ichi KANEKO, Hisae SHIBUYA, Shunji MAEDA, Tsutomu NITTOBE, Masami IIZUKA and Toru NAKAYAMA

J. JSPE, Vol.80 No.12 pp.1182-1188

Bullet identification is the difficult work that only specialists can do. It requires a high level of skill and takes a long time. So we are trying to assist appraising workers by using an image processing technology. In this paper, we propose a method to express the similarity between two bullets numerically and to estimate whether two bullets were fired by the same firearm.

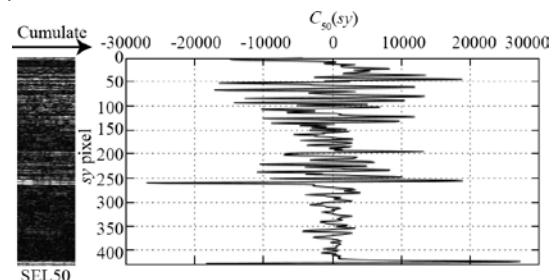


Fig.3 An example of CGD

Introduction of JSPE Numata Memorial Paper Awards 2014

1. Modelling the Start Conditions of Fine Particles Self-assembly in Groove on

Hydrophilic/Hydrophobic Patterned Substrate

Manabu NISHIO, Nobuyuki MORONUKI and Arata KANEKO

J. JSPE, Vol.80 No.2 pp.172-176

Patterned fine particles enable a lot of applications. Hydrophobic/hydrophilic patterning with groove on a substrate is effective in site-selective dip coating in which suspension including particles spreads on desired area and then particles assemble with the evaporation of solvent. This paper aims to construct a model of the self-assembly process including the conditions of assembly start or not on such substrate. We investigated the height and shape of suspension spreading over hydrophilic/hydrophobic patterned groove. In addition, critical local contact angle which determines the self-assembly will start or not was modeled. In order to verify this hypothesis, we examined both effects of change in contact angle on hydrophobic region and groove depth on the particles assembly. It was found that the width can be estimated based on the local contact angle of the spreading profile.

2. Study on Measurement of Nanoparticles Size Based on Fluorescence Polarization (1st Report) —Development of Rotational Diffusion Coefficient Measurement System Using Fluorescent DNA Probe—

Yuki ISHIZAKI, Terutake HAYASHI, Masaki MICHIHATA and Yasuhiro TAKAYA

J. JSPE, Vol.80 No.2 pp.214-219

Nanoparticles are attractive materials in the area of nanotechnology, and there is a need to measure the particle size accurately and easily. We suggest a novel particle sizing method based on fluorescence polarization. Particle size evaluation can be achieved from measuring the rotational diffusion coefficient which is sensitive to the particle size. We develop the rotational diffusion coefficient measurement system using fluorescent DNA probe. We verify the feasibility of proposed method by a fundamental experiment. We measure the rotational diffusion coefficient of gold nanoparticle whose diameter is 8.2nm. The rotational diffusion coefficient decreases by 50% compared to the reference value in the measuring range. The result indicates that nanoparticle, whose diameter is as small as 8.2nm, can be measured.

Report of The 15th International Conference on Precision Engineering (ICPE2014)

The 15th International Conference on Precision Engineering (ICPE2014) was held on July 22nd through 25th, 2014 in Kanazawa City, Ishikawa, Japan. ICPE is the principal international conference of the Japan Society of Precision Engineering (JSPE) and is held every other year.

A total of 339 researchers and engineers from 11 countries, including Germany, China, Taiwan, USA and Switzerland, attended the conference, and 238 academic contributions were presented. The diverse fields of research are summarized in Table 1.

Keynote speeches were given by four excellent speakers: Prof. Alexander H. Slocum (MIT, USA), Mr. Kunio Noji (Komatsu Ltd., Japan), Mr. Thomas Ittner (Carl Zeiss, Germany), and Emeritus Prof. Kanji Ueda (Univ. Tokyo, Japan). The keynote speeches were open to everyone.

Papers were presented in 30 oral sessions and a poster session. One of the 92 posters was presented by Izumigaoka high school students, and it was encouraging to see these young people participating in the conference and presenting their research. At the banquet held after the poster session, attendees enjoyed delicious food and

entertainment, including a traditional Japanese-style dance and drum show (Fig.4). Best paper awards given to 13 papers were announced at the banquet.

A pre-conference tour of the facilities of the Nakamura-tome Precision Industry Co., Ltd. and the Kanazawa Phonograph Museum was conducted on July 22nd. The tour was followed by a welcome reception at the beautiful and historic Shiinoki cultural complex. A post-conference tour of the facilities of Sugiyu Co., Ltd. and Kagaya Ryokan, a famous Japanese-style hotel, was held on July 26th.

The many attendees, many interesting presentations, and enjoyable social events made ICPE2014 very successful. We look forward to seeing you at ICPE2016, which is scheduled to be held in Hamamatsu City, Shizuoka in November 2016.

Table 1 Number of papers

High precision machining	40	Measurement engineering	18
Non-conventional machining	32	Design engineering	3
CAD/CAM technology	19	Service engineering	4
Machining control	8	Medical devices	5
Machine tools	19	Green manufacturing	7
MEMS/NEMS	12	Advanced molding and forming	12
Precision devices	2	Other related technologies	16
Mechatronics	26	Technical session	5
Tribological systems	9	Research of high school students	1



Fig.4 Traditional Japanese-style drum show at Banquet