The Japan Society for Precision Engineering

Introduction of JSPE Young Engineer Awards 2010

1. Development of the coaxial optical system for ultra compact high performance angular sensor

Takeshi MUSHA (Mitsubishi Electric Corporation)

The award has been conferred for the realization of an ultra compact optical angle sensor for a small and high precision compatible ultra compact servomotor, based on a unique design of the optical system and a light receiving element (photo detector) optimization design. In particular, when the light source (LED), optical system and light receiving elements (photo detectors) are arranged coaxially, it makes possible to construct a smaller scale disc with an outer diameter of φ11mm. Moreover, high precision is achieved by arranging light receiving elements (photo detectors) along the circumference. The developed rotation angle sensor is practically used as an actual sensor for an ultra compact servomotor. This technology has the capability to further support ultra compact and high performance (high resolution and accuracy) and is thus expected to contribute to the future of industrial growth. Therefore, the JSPE Young Engineer Award is presented for this achievement.

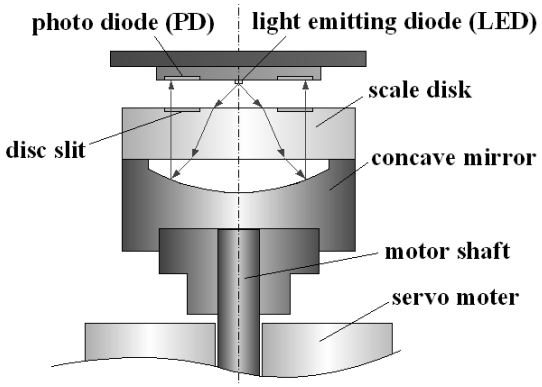

Fig. 1 Optical system of the sensor

2.Study on control of MEMS mirror tilt angle using in optical switch

Naru NEMOTO (Nippon Telegraph and Telephone Corporation)

The award has been conferred for improvements in the angular precision of mirrors by controlling the tilt angle drift that arises from floating charges, which is a major issue for the MEMS optical switch. In particular, the tilt angle drift gets reduced with the introduction of new mirror driving system that is based on the AC drive. Furthermore, the candidate has also succeeded in compensating the tilt angle drift at high speed using feedback control. This gives rise to a technology applicable to various MEMS devices and, it is expected to contribute to the future of industrial growth. Therefore, the JSPE Young Engineer Award is presented for this achievement.

3. Improvement of High Aspect Ratio Contact Etching Performance by using Real-Time Wafer Temperature Control

Takumi TANDOU (Hitachi, Ltd.)

The award has been conferred for the development of a high-speed temperature control system for wafers and the improvement in performance of high-aspect-ratio contact hole (HARC) etching using the aforementioned technology. Controlling the temperature of wafers is an important technology for HARC etching. In this achievement, high temperature control accuracy is reached with the introduction of a direct expansion system (or System based on direct expansion phenomenon of coolant). Moreover, it substantiates that, by using this system, the etching rate can be improved while maintaining the etching profile. This technology is also effective for other precise etching processes and thus, it is expected to contribute to the future of industrial growth. Therefore, the JSPE Young Engineer Award is presented for this achievement.

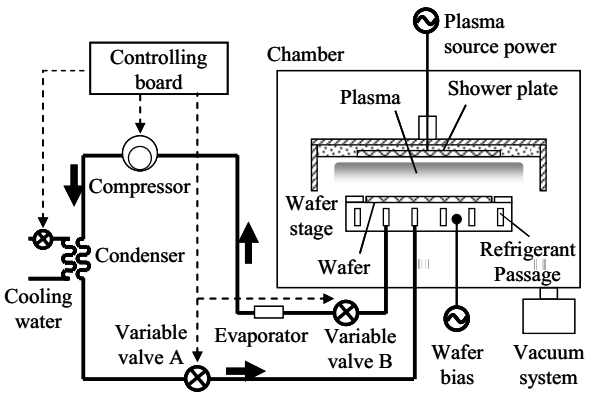

Fig. 2 Total configration of the temperature control system

4. Development of Measuring Instrument of Tool Tip Position Using Incoherent Light

Shinya SUZUKI (Toyama National College of Technology)

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The award has been conferred for the development of an on-machine instrument for taking measurements of gaps between the tool and the workpiece with a high degree of precision, using incoherent light. For ultra precision machining that uses micro-tools, it is an important technology or system that determines the relative position between the tool and the workpiece with high accuracy, in a short period of time. In this feat, the gap between the tool tip and the workpiece is directly monitored from a peripheral cutting edge side. The intensity of light that passes through it is dependent on a parameter, which is proportional to the square of the gap and makes an on-machine instrument by way of trial to measure the gap (as mentioned above). The result corroborates that through this system the gap can be measured accurately within a short period of time. This technology is effective for a variety of ultra precision machining and is expected to contribute to the future of industrial growth. Therefore, the JSPE Young Engineer Award is presented for this achievement.

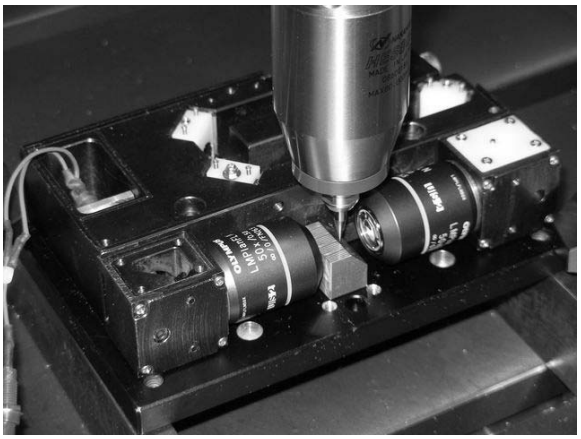

Fig. 3 Outside view of the tip position measurement system

Introduction of FANUC FA and Robot Foundation Award

[Paper Award 2010]

A Study on Control Structure for Slide Screw Stages - Mechanical Nonlinearity and Control Optimization -

Susumu MAKINOUCHI, Hideaki SAKAMOTO and Shinji WAKUI

J. JSPE, Vol.75, No.8

A slide screw drive is a kind of old technology. However it is usable and important technology even in high-tech fields such as semiconductor manufacturing. This paper intends to improve the slide screw controllability which has strong non-linearity due to grease characteristics. We measured the grease non-linear viscosity using a special tool. This grease property explains the shot dislocation phenomenon which occurs in slide screw stages particularly. Since we understood the phenomenon, we found one non-linear gain control method which embedded the grease property reversely. It not only fixed the dislocation problem but also enhanced the slid screw stage performance and maintainability.

Introduction of The 32th Machine Tool Engineering Foundation Award

[Paper Awards 2010]

1. Machining tests to identify kinematic errors on five-axis machine tools

Soichi IBARAKI, Masahiro SAWADA, Atsushi MATSUBARA and Tetsuya MATSUSHITA

Precision Engineering, Vol.34, No.3

2. Evaluation of Adhesion on Tool-Chip Interface with Dynamic Components of Cutting Force

Ryo TEZUKA, Katsuhiko SEKIYA, Keiji YAMADA and Yasuo YAMANE

J. JSPE, Vol.76, No.8

A new method for evaluation of adhesion in cutting is proposed. Adhesion of chip induces fluctuation in chip flow or stick-slip movement of chip, so that dynamic component of cutting forces depends on the cutting conditions and properties of the work materials. Continuous turning of a medium carbon steel, a titanium alloy and a nickel-based super heat resistant alloy were carried out. Dynamic components of cutting force were measured by piezoelectric dynamometer. In cutting of a medium carbon steel, the dynamic components below 500Hz increased under the condition of build-up edge (BUE) formation, and gradually decreased with increase of cutting speed. Deposits of work piece on tool face were also observed under conditions in which the power spectrum of cutting force showed peaks. Authors defined friction-coefficient vector on rake face of cutting tool. Fluctuation in the friction-coefficient vector was calculated as for a range of cutting speeds under dry condition and emulsion supply in order to investigate the relationship between adhesion and fluctuation of the dynamic components. Tendency to adhesion was evaluated with newly defined index among a carbon steel S45C, a titanium alloy Ti-6Al-4V and a nickel-based super heat resistant alloy Inconel718, yielded good agreement with empirical rules.