The Japan Society for Precision Engineering

Introduction of JSPE Young Engineer Awards 2013

1. Naohiro NISHIKAWA (Iwate University)

Proposal and Development of the Electric Rust Preventive Machining Method System for High Safety Environmentally Friendly Manufacturing Machine Tool System with Using Water as Machining Coolant

In the present study, we have developed an Electric Rust Preventive Machining Method System for cutting and grinding that uses pure water as the machining fluid, which is not harmful to humans or the environment. Process machinery and workpiece rust due to corrosive water has been a problem in the past, but the present technology using the electrochemical method enables machining using water without any other chemicals such as rust preventative agents. Furthermore, the developed technology holds promise for the prevention of scratch damage to workpiece surfaces caused by sludge, and for the development of ultra-precision machining without surface chemical contamination. Therefore, the JSPE Young Engineer Award is presented for this achievement.

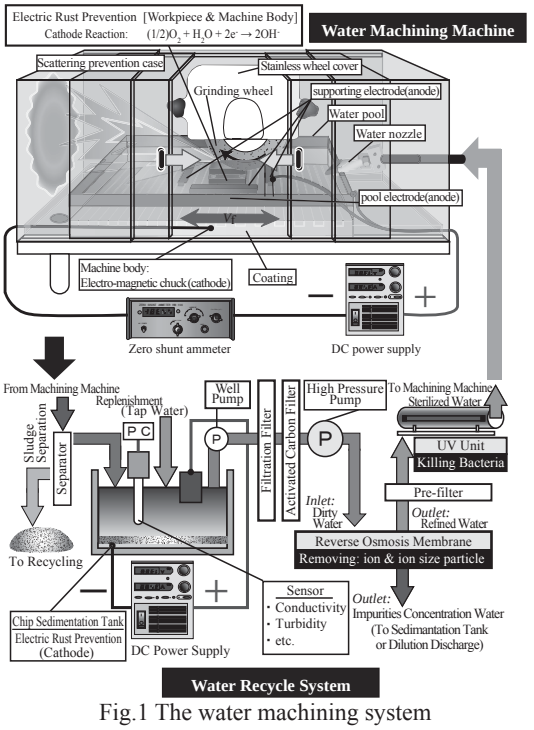

Fig.1 The water machining system

2. Motohiro TAKAHASHI and Hironori OGAWA (Hitachi, Ltd)

Nanometer-Scale Vibration Canceller for Ultra Precision Positioning Stage

An active vibration cancelling system with high responsiveness and high stiffness was developed for ultra-precision positioning stages used in, for instance, semiconductor manufacturing systems, which performs active vibration control by causing elastic deformation of the table. The system eliminates nanometer-scale vibration. The developed nanometer-scale vibration canceller can also be applied to stages in vacuum environments that are not affected by magnetic fields, and it is a promising innovative technology for semiconductor manufacturing systems of the future. Therefore, the JSPE Young Engineer Award is presented for this achievement.

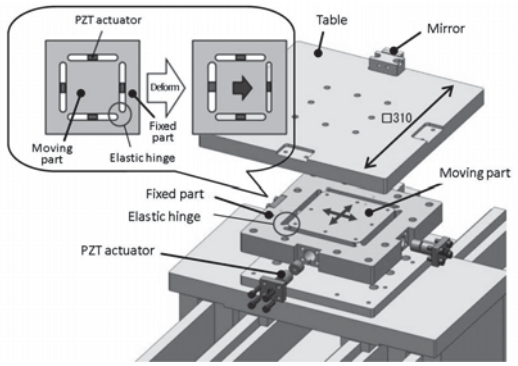

Fig.2 Configuration of the vibration canceller

3. Junji MURATA and Takeshi TSUCHIDA (Ritsumeikan University)

Damage-Free Slicing for Photovoltaic Si Using a Wet Chemical Etching

A new chemical slicing method has been developed as an alternative for machining in the Si wafer manufacturing process to reduce manufacturing costs for photovoltaic cells. The developed machining method facilitates etching at the abrade point while also abrades Si ingots with a wire, thus enabling slicing without damaging the wafer. Moreover, because kerf loss is substantially reduced, the technology makes it possible to slice more wafers from a Si ingot and holds promise as a machining method that can contribute to renewable energy technologies. Therefore, the JSPE Young Engineer Award is presented for this achievement.

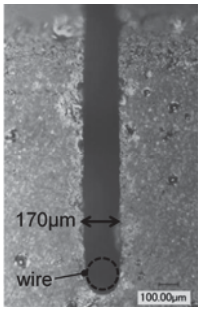

Fig.3 Optical microscope image of Si kerf processed using the developed slicing method

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4. Reona NAKAMURA and Tomotaka KATSURA (MITSUBISHI Electric Corporation)

Micro-Laser Drilling on Glass Substrates with Pulsed CO_2 Lasers

A proprietary processing technology with CO_2 lasers was developed, which prevents the formation of cracks and the attachment of debris while drilling micro-holes in glass, thus forming high-quality micro-holes. In addition to ascertaining the laser processing conditions for machining 40-μm-diameter micro-through-holes in 200-μm-thick glass, we achieved a machining speed of 800 holes per second through the use of galvo scanners. The developed technology holds promise for application to manufacturing processes of, for instance, glass interposers. Therefore, the JSPE Young Engineer Award is presented for this achievement.

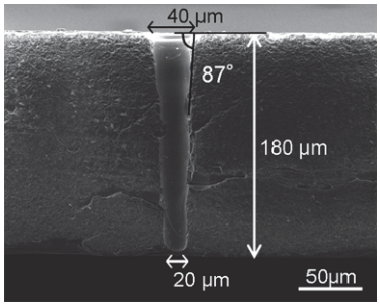

Fig.4 Cross-section of the processing a through-hole

5. Qiyue YU (Nagoya Institute of Technology)

Development of Compact 3D Measurement System Using Single-Shot Phase-Shift Digital Holography

A compact 3D measurement system was developed through the application of single-shot phase-shift digital holography, which enables calculation of the relative phase distribution of object waves from the interference fringe in one image. It enables the measurement of specular reflection and transparent objects, which have been difficult to measure with existing 3D measurement methods, and it is characterized by both high speed and stable measuring performance. The developed technology holds promise for the widespread application of precision measurements of industrial goods, including 3D shape output devices. Therefore, the JSPE Young Engineer Award is presented for this achievement.

Introduction of FA Foundation Award

[Paper Awards 2012]

Reduction of Force Interference and Performance Improvement of a Consequent-Pole Bearingless Motor

Junichi ASAMA, Ryo KAWATA, Tomoyasu TAMURA, Takaaki OIWA and Akira CHIBA

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A bearingless motor combines the functions of both magnetic suspension and torque generation together in a single motor. A consequent-pole type of bearingless motor has already been proposed. In contrast to conventional bearingless motors, it is free from the trade-off between suspension force and torque. In addition, stable suspension can be achieved without detecting the rotational angle. However, a part of the X-axis current generates undesirable force in the Y-axis. This force interference influences the performances of bearingless motors; thus, the interference should be eliminated. In this paper, the authors propose an optimal winding design of the consequent-pole bearingless motor to minimize the suspension force interference. Here, the suspension forces in the radial direction are numerically calculated using the magneto-motive force distribution of the bearingless motor, and are compared with the analytical results of finite element method. To verify the theory, static and dynamic performance tests were carried out. It was found that the improved winding configuration significantly reduced the suspension force interference by 90% compared with the previous winding configuration. It was also found that the radial shaft vibration and the power consumption were considerably decreased, by approximately 16% and 44%, respectively.

[Paper Awards 2013]

Path Generation Using Linear Curvature and Torsion Segments

Fengli LAN, Hirofumi TAMAI, Kenjiro T. MIURA and Hiroshi MAKINO

J. JSPE, Vol.78, No.7, pp.605-610

In two-dimensional (2D) space, the clothoid is a preferred trajectory curve because its curvature varies linearly with its curve length. However, in three-dimensional (3D) space, both curvature and torsion must be considered. This paper deals with path generation using linear curvature and torsion segments which can be considered a 3D extension of the 2D clothoid. In our study, the path segments are generated by solving the Frenet-Serret equation. In every path segment, its curvature and torsion varies linearly with its curve length. In order to obtain more free parameters, plural curve segments are connected in series to make a compound curve. The curve is used to connect two given points which may have given Frenet-Frame, curvature and torsion constraints. These curves are also used to construct a smooth transition passing through an arbitrary point sequence. The resultant path possesses C^2 as well as torsion continuity and matches all given Frenet-frame, curvature and torsion constraints at the given points.