The Japan Society for Precision Engineering

Introduction of JSPE Best Paper Awards 2016

1. Development of CFRP Vessel with Multiple TPP Supply FW Method s– Influence of the Transition of Lamination Angle on the Strength of Vessels-

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In this study, we have proposed a new method to manufacture high pressure composite vessels for hydrogen storage. With the new method, a new filament winding machine which has multiple delivery eyes is used. By laminating composite layers with a lot of delivery eyes at once, the manufacturing time decreases significantly. To eliminate the trouble of tying ends of a lot of fiber bundles which has been a problem in this method, we have added layers for continuous changing the lamination angle in a winding pattern. To evaluate the effect of above layers on the strength of the vessel, we manufactured prototype composite vessels using the above mentioned method with different conditions, and compared with conventional vessels. By adding layers for changing the lamination angle, it became possible to laminate all layers of a vessel continuously. Furthermore, by changing the lamination angle to decrease the gaps between fiber bundles in the layers, the experimental-by-ideal strength ratio improved 21%, and the material usage efficiency improved 29%.

2. Fundamental Study on Tapered Roller Screw - Design for Infinitesimal Slip and Verification of Mechanical Efficiency -

Hiroyuki YAMADA, Saku EGAWA (Hitachi, Ltd)

J. JSPE, Vol.82 No.5 pp.481-486

The roller screw mechanism is more suitable for high load than the ball screw mechanism, because it has a large contact area and a greater radius of curvature between a roller and a screw shaft. However, it is considered that the rolling mechanism which has large contact surface is easy to get a big slip ratio, and it generally has lower mechanical efficiency. In this study, to improve the mechanical efficiency of the roller screw mechanism, we devised the tapered roller screw mechanism (TRS). The shape of flank face of screw shaft and the surface of rollers of TRS is designed to minimize the slip ratio. As a result of experiment, it was confirmed that the apparent coefficient of friction was 0.0018 at minimum, and the mechanical efficiency was 0.985 at maximum. These results showed that the TRS was comparable to the ball screw mechanism in efficiency.

3. Damage of Physical Vapor Deposition Coatings of Cutting Tools during Alloy 718 Turning

Shuho Koseki, Kenichi Inoue (Hitachi Metals, Ltd) and Hiroshi Usuki (Shimane University)

Precision Engineering Vol.44 pp. 41-54

Ni-based superalloys are typically difficult-to-cut materials. Therefore, the lifespan of cutting tools used to cut these materials is shorter than that of tools used on other materials. This study develops a new coating for cutting tools that has properties required for the turning of Ni-based superalloys. This study examined the cutting performance of TiN-coated cutting tools deposited by arc ion plating according to the damage of the coating and determination of the required properties of the coatings. To evaluate cutting tool damage, many analysis methods were used at each step of damage accumulation. Plastic deformation of the coating was observed at rake and flank face edges by scanning ion microscopy and transmission electron microscopy (TEM). Furthermore, the fracture of the coating near the surface defects (e.g., droplets, voids) was due to the interaction between the work material and surface defects. Moreover, using electron probe microanalysis, scanning auger microscopy, and TEM, the work material was confirmed to adhere to the cutting edge physically or mechanically, not chemically. This means that oxidation and diffusion did not occur in the interface between the adhesive material and coating after cutting. Finally, the effectiveness of different coating types, varying in both composition and deposition method, was verified by evaluating the effect of damage reduction. Using coatings with greater stability at high temperatures and fewer defects can reduce damage of the coated cutting tools, increasing tool lifespan.

Introduction of JSPE Numata Memorial Paper Awards 2016

1. 3D-shape Measurement of Rough Surface Using Wavelength Shift Interferometer under Unavoidable Ramdom Changes of Optical Path Differences

Masaaki ADACHI, Yuuri SASAKI (Kanazawa University)

J. JSPE, Vol.82 No.4 pp.384-389

We propose a 3D-shape measurement technique of a

rough surface using speckle interferograms captured under ramdom changes of optical path differences. Amounts of the phase shifts between captured interferograms are calculated through Max & Min light intensities searchings at two different pixels in frames and twin normalizations of their intensity changes. The calculated phase shifts which involve random changes over 2π are used to extract phase distribution of a speckle interferogram. After capturing 175 specklegrams which consist of 25 specklegrams at wavelengths of around 778.201nm, 778.217nm, 778.258nm 778.366nm, 778.623nm, 779.151nm and 780.260nm, phase distributions are extracted regarding the first captured interferogram in each wavelength. These distributions normally involve uncertain offsets due to random shifts. After canceling these offsets with the phase data at a base-height pixel selected arbitrarily, the ratios of phase change against wavelength change are extracted at all the pixels. 3D shape is calculated from the extracted ratios.

2. Elliptical Vibration Cutting of Hardened Die Steel with Coated Carbide Tools

Hiroshi Saito (Yamagata Research Institute of Technology), Hongjin Jung and Eiji Shamoto (Nagoya University)

Precision Engineering Vol.45 pp.44-54

Elliptical vibration cutting of hardened die steel with coated carbide tools is examined in this research in order to achieve low-cost high-precision machining. Diamond coated tools are applied because of superior hardness of their polycrystalline diamond coating and its low manufacturing cost. TiN coated tools are also tested, since they are widely used for conventional machining of steels. Machinability of hardened die steel by the elliptical vibration cutting with coated carbide tools is discussed in three aspects in this study, i.e. transferability of cutting edge profile to cut surface, cutting force, and tool life. The transferability is evaluated quantitatively by calculating correlation coefficients of measured roughness profiles. It is clarified that the diamond coated tools have high transferability which leads to diffraction of light on the surface machined at micro-scale pick feed. Total cutting forces including ploughing components are measured at various feed rates, and then shearing components and ploughing components are separated utilizing linear regression. The measured results indicate, for example, that the all forces become considerably smaller only when elliptical vibration is applied to the TiN coated tool without cutting fluid. It is also found that this considerable reduction of forces interestingly corresponds to higher friction coefficient, which is identified from the ploughing components. Tool life tests are carried out by various machining methods, i.e. elliptical vibration/ordinary wet/dry cutting with diamond/TiN coated tools. The result shows, for example, that the flank wear is smallest in the wet elliptical vibration cutting with the diamond coated tool.

Report of 16th International Conference on Precision Engineering (ICPE2016)

The 16th International Conference on Precision Engineering (ICPE2016) was held on Nov. 14th~16th, 2016 in Hamamatsu City, Shizuoka, Japan. ICPE is the principal international conference of the Japan Society for Precision Engineering (JSPE) and held every other year.

ICPE2016 consists of plenary session, oral session and poster session. Four keynote speakers, Dr. Sinan Badrawy (Moore Nanotechnology Systems, USA), Prof. Hans Norgaard Hansen (Technical University of Denmark), Prof. Atsushi Matsubara (Kyoto Univ., Japan) and Dr. Kei'ichiro Watanabe (NGK Insulators Ltd., Japan) gave their excellent talks in the plenary session. A total of 102 presentations were made in three parallel oral sessions while 47 presentations in a poster session. The topics cover 10 disciplines closely related to precision engineering, including precision machining, metrology, additive manufacturing, machine tool, medical engineering.

231 researchers and engineers from 9 countries, including Germany, China, Korea, Slovenia, USA, Denmark and India, attended the conference.

At the banquet held after the poster session, attendees enjoyed delicious food, jazz music and a traditional Japanese "Musha" performance.

"Kagamiwari" at banquet

A post-conference tour was organized to visit the facilities of Hamamatsu Photonics K.K., a highly-reputed photonics device manufacturer.

We look forward to seeing you at 17th ICPE, which is scheduled to be held in a historic city, Kamakura, Kanagawa in November 2018.