

Utsunomiya and Central Tochigi Area

Development and Industrial Applications of Ultra-precision Magnetic Field Assisted Machining Processes

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Project Promotion

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Major Participating Research Organizations

Industry... IZUMO INDUSTRIAL CO., LTD., KUWANA, CO., LTD., SUZUKI PRECISION CO., LTD., MARUI-KEIKI CO., LTD.
Academia... Utsunomiya University, School of Science and Engineering Teikyo University, Kanto Polytechnic College
Government... Industrial Technology Center of Tohigi Prefecture

Core Research Organization

Utsunomiya University

Aim of research and development

Automobile and aerospace and aircraft industries are active and popular in Tohigi Prefecture Area. A lot of enterprise which possesses the precision machining technology exists. "Magnetic Field Assisted Machining Process" is a new machining technology which enables ultra-precision machining process which can not realize in conventional processes. This process is effective for world market created and developed at Utsunomiya University in Japan. This new machining technology is made to be a theme, the university/industry shrine cooperation network is constructed, and the creation of technology seeds which specialized in the field is attempted. This new technology can be applied to mirror finishing of various capillary inside, mirror finishing of the minute and metallic surface, deburring and precision edge finishing of the minute parts. In addition, it can be also applied to the surface modification. Moreover, the research seeds that derive from not only practical use but also the research and development are united by the coordination activity with corporate needs and the creation of a chain research and development is aimed at. It contributes to the improvement of the technological level of regional industries in Tohigi Area, activation, talent's promotion and exchange of the technologies.

* Magnetic invoking processing

New technology to which part that cannot be processed by prior art is processed with processing Cou using magnetism

* Mirror finish

It is 0 as for the surface roughness of the machined surface . It finishes it up in the corrugated surface of one micron or less.

* Burr

Protruded extra material formed on the edge etc. in process of mechanically processing precision part

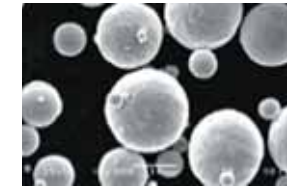
Contents of research

1. Development of internal finishing process using Magnetic field assisted finishing for slender tubes
Study the internal finishing process of tubes used for critical applications, e.g., high purity gas and liquid piping systems, in aerospace components and semiconductor plants. Generate nanometer-scale mirror finished surface with development of novel magnetic abrasive.
2. Development of super precision magnetism invoking grinding technology of minute metal mold
The application and the feasibility study of the Nano level magnetic grinding technology that takes the place of The development of the magnetic grit made by the electrochemical circuit technique is advanced, and the minute metal mold magnetism grinding and it grinds the CMP are developed. (Chemical Mechanical Polishing)
3. Development of deburring technology for micro and precise part by the application of magnetic field assisted method
A new magnetic-field-assisted deburring technology, by the application of that the machined burr formed in the inner surface of the complex shape part is removed and it can be realized the precise edge finishing, it is possible to aim the development of the precise edge finishing technology and the practical use. Moreover, it aims at development and the practical use of the micro machining technology by the ultrasonic vibration machining method.
4. Development of internal machining process for surface modification of slender tubes using magnetic field assisted machining
Study the effects of shapes of magnetic tool edges on the surface integrity of inner surfaces of slender tubes. Propose the conditions required so that the magnetic tools impart compressive residual stress into the inner surfaces of tubes for industrial applications.
5. Development of magnetic invoking ultraprecision machining plasma generator
The profile irregularity of the capillary inner surface is improved by using the magnetic grinding technology from considering greatly contribute to the excitation of the plasma wake field the profile irregularity of the capillary inner surface, and relate greatly to the energy of the generation electron, it experiments, and the concept of new, micro accelerating agent with the ultra short-pulse laser is demonstrated.
6. Development of magnetic invoking grinding technology of hydroformed small diameter tube
Forming condition of the tube depends not only on the tube material but also on forming shape. This research and development is carried out through forming process designing by use of computer simulation and experimentation with a forming apparatus.

The main study results

1. Development of novel magnetic abrasive

Develop gas-atomized magnetic abrasive, sufficient to finish stainless steel tubes used for high purity gas piping systems. Further research will lead the gas-atomized magnetic abrasive to practical use. Moreover, develop magnetic media made by electrochemical method, magnetic abrasive with plastic core, etc .



Magnetic abrasive grain with gas atomization

2. Manufacture practical prototype machines for internal finishing and deburring by magnetic abrasive finishing

Manufacture a prototype machine for internal finishing of tubes and handy-type deburring machine. Consultation and technical discussion show feasibility of practical application of the magnetic field assisted finishing and deburring processes .



Magnetic polishing apparatus for inner face of circular tubes

3. Development of hydroforming apparatus for small diameter tube

Computer simulation techniques and a hydroforming apparatus for small diameter tube were developed. In addition to appearance and surface inspection of hydroformed tube, experimental studies were conducted on deformation of the crystal grains and those boundaries .



Hydroforming equipment for narrow tubes and its forming image

4. Development of micro machining by ultrasonic vibration machining method

A longitudinal ultrasonic vibration is applied to the cutting tool to the development of machining technology of micro honeycomb shape etc .



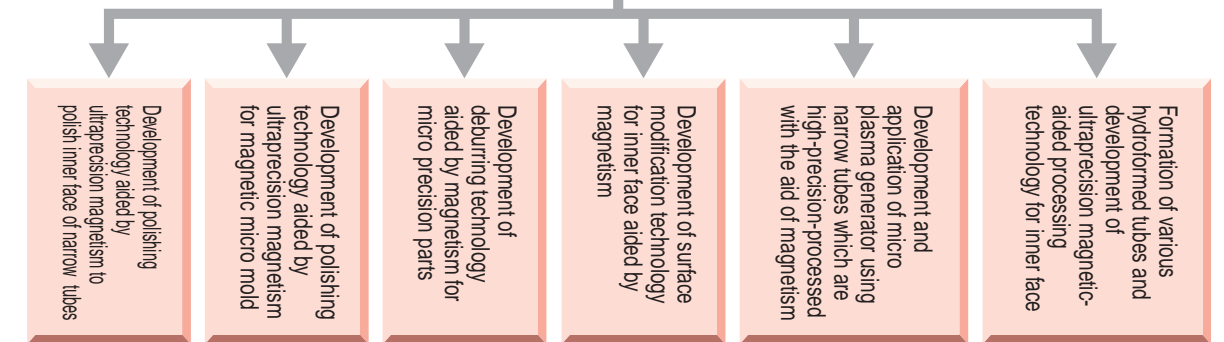
Honeycomb processing with supersonic vibration cutting

Main Theme: Development and Application of Ultraprecision Machining Technology Using Magnetism

- (1) Utilization of object transmission phenomenon of magnetic ray
- (2) Distant control using magnetic force for process and motion abilities of tools (attraction magnetic field, opposition magnetic field, changing magnetic field)

Superfine processing to places where you cannot see, where tools cannot reach, and where space is too narrow

Creation and value-addition of "ULTRA" precision processing technology which cannot be followed by existing technologies



Practical application of magnetic-aided processing technology Creation and commercialization of internationally competitive new industries