P1: Improvement of Machining Performance in Electrical Discharge Machining using Dielectric-encased Wire Electrode for Deep, Narrow Hole Fabrication in Metal
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We are developing a new electrical discharge machining (EDM) system in order to fabricate a narrow, deep hole in metal. Instead of a conventional pipe electrode system, a wire encased in a dielectric pipe which served as a jacket was employed as the tool electrode in this system. A role of the jacket is to completely suppress unnecessary secondary discharges occurring between the sidewalls of the wire and the fabricated hole. The working fluid flows between the external wall of the wire and the interior wall of the jacket to cool down the drilled portion and to flush out residual debris produced as a byproduct of drilling. In the present study, we examined an effectiveness of a combinational use of conductive working fluid and a capacitor connected to the work piece and the tool electrode. The machining speed under this combinational use (saline water at 150-250 μS/cm and capacitance at about 8 μF) was twice or more higher than that under no use of a capacitor and saline water in fabricating a hole (diameter: 0.8-0.9 mm) in a 20 mm thick carbon steel block.

P2: Optimization of Thermal Preprocessing for Efficient Combustion of Woody Biomass
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A thermal power plant using scrap woods is a small-scale, on-site and carbon-neutral system, providing several benefits over existing large-scale power plants. Its latent moisture and hygroscopic nature, which causes moisture uptake, reduce and fluctuate the generated power converted by the heating value of wood combustion due to endothermic vaporization of moisture. Higher temperatures can remove more moisture adsorbed in woods in a shorter time, but may also remove more flammable matters contributing to heat release during combustion. In the present study, we studied moisture release in the stem and bark of Japanese cedar grown in Akita Prefecture, Japan, during air drying in an oven. Higher and lower heating values of the stems and bark dried at different temperatures and for different lengths of time were evaluated. The optimum drying condition accomplishing the highest net heating value was obtained with stems dried at 180 °C for 30 min.

P3: Evaluation of Erosive Wear Properties of High V-Cr-Ni Cast Iron with Spherical Carbides
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To clarify the erosion mechanism of high V-Cr-Ni cast iron with spherical carbides, the authors carried out erosion tests using a shot blast machine with silica sand of average diameter 450μm and observed vertical section near the surface. Furthermore, it was recognized that the hardness of eroded surface after erosion test (482HV) is higher than that (399HV) of specimen before test. High V-Cr-Ni cast iron with spherical carbides showed better characteristics of resistance of sand erosion because of its work-hardening effect. It can be made a conclusion that the mechanisms of High V-Cr-Ni cast iron with spherical carbides also is, just like the others materials that have been concluded previous study, the cutting wear and deformation wear.

P4: Precision Small Angle Bending of Sheet Metals Using Shear Deformation
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In sheet metal bending, bending tools are designed in prospect of spring back after unloading. Although the accuracy of spring back analysis has been improved, small errors in thickness or material properties lead to variations in bend angles, which become marked especially in bending high strength metals or high modulus metals. In order to correct the bend angle, we proposed a new method for small angle bending. In this process, a sheet metal is slightly bent by shear deformation under the negative clearance conditions. Experiments with pure aluminum, high strength steels and phosphor bronzes revealed that bend angles were determined by the localized material flow around the punch edge and that it could be changed by tool conditions. In addition, a good linear relationship between the penetration depth of punch and the bend angle was observed, which was effective to control bend angles in this process. Based on this relationship, optimum bending conditions were shown and flexible and precise bending within 10-degree angle was demonstrated with one punch-die system by changing tool conditions. This method was applied to correct the angular deviation in U-bend products of high-strength steel and to bend leaf springs of phosphor bronze at an arbitrary small angle.

P5: Dry Cutting of Corona-Discharge Plasma Radiated Stainless Steel
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Effects of corona-discharge plasma radiation on the surface of austenitic stainless steel (JIS SUS304) have been studied on orthogonal dry cutting. The size of cutting surface was 1.5mm in width and 75mm in length, the cutting speed was 1.67mm/s, and the radiating time was focused on 1s. When the depth of final pre-cut: tf=1=10μm and the depth of finish cut: tf =20μm, the cutting forces and their periodic fluctuation increased at the radiated region as compared to the non-radiated region for the pre-cut specimens. Similar results were obtained from the specimens cut in Ar atmosphere without radiating. The surface finish in the radiated region became poor and the shape of chip changed from the continued tear type for the non-radiated region to the intermittent tear type for the radiated region. In addition, the effects of plasma radiation became weaker with increasing depth of final pre-cut. As the leaving time after plasma radiation got longer, effects of plasma radiation became weaker and almost disappeared after about 16 hours. It would be considered that the fine oxide film on the surface formed after pre-cut was broken and even removed by sputter etching effect of plasma radiation. But with time going on, the oxide film of the surface of the radiated region turns back, and the effects of plasma radiation disappear.

P6: Precise Micro Pattern Replication by Hot Embossing
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