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IPR News: India Still Behind China In Intellectual Property Generation: Cisco

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109680  Mechanism of synergetic material removal by electrochemomechanical magnetorheological polishing
Jang, Kyung-In; Nam, Eunseok; Lee, Chan-Young; Seok, Jongwon; Min, Byung-Kwon [Int J of Machine Tools & Manufacture, v 70, Jul 2013, Starting Page 88, Pages 5] The mechanism of material removal by electrochemomechanical magnetorheological polishing of glassycarbon (GC) products is studied in this paper. Potentiostatic experiment was performed to examine the electrochemical oxidation mechanism and the associated oxide film growth on GC. A nanoindentation test revealed that the oxide film had lower hardness than did the original GC. An electrochemical impedance spectroscopy experiment was carried out to model the electrochemomechanical material removal mechanism. A series of tribocorrosion tests were conducted to quantitatively study the tribocorrosion synergism. (16 refs, 5 figs, 3 tables) (AA)

ELECTRICALS & ELECTRONICS

109681  FIB deposited molybdenum micro contact for VLSI Circuit Edit
Sarat Kumar Dash; Khan, AM; Jaipal Doraismay; Ramachandra Chitakudige [Manufacturing Technology Today, v 13, n 3, Mar 2014, Starting Page 9, Pages 4] Platinum and tungsten have been widely used for making electrical contact using FIB for circuit edit. However they find limitation in small structure via filling. Molybdenum is becoming one of the promising materials to be used in FIB for electrical contact. Electrical characterization of FIB deposited molybdenum contact is described in this paper. Electrical resistivity, via filling capability, electro migration resistance and environmental resistance of FIB deposited molybdenum has been studied. FIB deposited molybdenum has shown better via filling capability and improved electro migration resistance. However molybdenum contacts are found to be susceptible to humidity induced degradation. Recapping the device after circuit edit with appropriate epoxy potting compound is found to provide excellent protection against humidity induced degradation. (8 refs, 5 figs, 1 table) (AA)

JOINING & ASSEMBLY

109682  Experimental analysis of friction stir forming for dissimilar material joining application
Lazarevic, Sladjan; Miller, Scott F; Li, Jingjing; Carlson, Blair E [J of Manufacturing Processes, v 15, n 4, Oct 2013, Starting Page 616, Pages 9] Friction stir forming a new manufacturing process for joining dissimilar materials. The concept of this process stir heating one material and forming it into a mechanical interlocking joint with the second material. In this research the process was experimentally analyzed in a position controlled robotic friction stir welding machine between aluminum and steel workpieces. New tool geometries were evaluated toward the goal of optimizing joint strength. The significant process parameters were identified and their optimized settings for the current experimental conditions defined using a design of experiments methodology. A scanning electron microscope was used to characterize the bonding and joint structure for single and multi-pin configurations. Two failure modes, aluminum sheet peeling and bonding delamination, i.e. braze fracture, were identified. It was found that the presence of zinc coating on the steel and overall joint geometry greatly affected the joint strength. The aluminum–zinc braze joint appears to be the largest contributor to joint strength for the single-pin joint configuration. The multi-pin geometry enabled a distribution of load to the four pins following fracture of the braze for increased joint toughness and ductility. Thus, the FSF method has been shown to exhibit potential for joining of aluminum to steel. (18 refs, 12 figs, 2 tables) (AA)

109683  Metal-cored arc welding process for joining of modified 9Cr-1Mo (P91) steel
Arivazhagan, B; Kamaraj, M [J of Manufacturing Processes, v 15, n 4, Oct 2013, Starting Page 542, Pages 7] In the present work, metal-cored arc welding process was used for joining of modified 9Cr-1Mo (P91) steel. Metal-cored arc welding process is characterized by high productivity, slag-free process, defect-free weldments that can be produced with ease, and good weldability. Toughness is essential in welds of P91 steel during hydro-testing of vessels. There is a minimum required toughness of 47 J for welds that has to be met as per the EN1557:1997 specification. In
the present study, welds were completed using two kinds of shielding gases, each composition being 80% Argon + 20% CO₂, and pure argon respectively. Microstructural characterization and toughness evaluation of welds were done in the as – weld, PWHT at 760 °C – 2 h and PWHT at 760 °C – 5 h conditions. Thermo-calc windows (TCW) was used for the prediction of equilibrium critical transformation points for the composition of the welds studied. With increase in post-weld heat treatment (PWHT) duration from 2 h to 5 h, there was increase in toughness of welds above 47 J. Using metal-cored arc welding process, it was possible to achieve the required toughness of more than 47 J after PWHT at 760 °C – 2 h in P91 steel welds. (17 refs, 16 figs, 5 tables) (AA)
**Abstracts**

109688 Total differential methods based universal post processing algorithm considering geometric error for multi-axis NC machine tool

Peng, FY; Ma, JY; Wang, W; Duan, XY; Sun, PP; Yan, R [Int J of Machine Tools & Manufacture, v 70, Jul 2013, Starting Page 53, Pages 10] Multi-axis numerical control machining for free-form surfaces needs CAD/CAM system for the cutter location and orientation data. Since these data are defined with respect to the coordinate of workpiece, they need converting for machine control commands in machine coordinate system, through a processing procedure called post processing. In this work, a new universal post processing algorithm considering geometric error for multi-axis machine tool with arbitrary configuration. Firstly, ideal kinematic model and real kinematic model of the multi-axis NC machine tool are built respectively. Difference between the two kinematic models is only whether to consider the machine tool's geometric error or not. Secondly, a universal generalized post processing algorithm containing forward and inverse kinematics solution is designed to solve kinematic models of multi-axis machine tool. Specially, the inverse kinematics solution is used for the ideal kinematic model, while the forward kinematics solution is used for the real kinematic model. Then, a total differential algorithm is applied to improve the calculation speed and reduce the difficulty of inverse kinematics solution. Realization principle of the total differential algorithm is to transform the inverse kinematics solution problem into that of solving linear equations based on spatial relationship of adjacent cutter locations. Thirdly, to reduce the complexity of geometric error calibration experiment, effect weight of geometric error components is determined by the sensitivity analysis based on orthogonal method, and then the real kinematic model considering geometric error is established. Finally, the universal post processing algorithm based on total differential methods is implemented and demonstrated experimentally in a five-axis machine tool. The results show that the maximum error value can be decreased to one-fifth using the proposed method in this paper. (25 refs, 13 figs, 2 tables) (GM)

109689 Model-based computationally efficient method for on-line detection of chatter in milling

Ma, Lei; Melkote, Shreyes N; Castle, James B [J of Manufacturing Sci & Engg:ASME Trans, v 135, n 3, Jun 2013, Starting Page 031007-1, Pages 11] Presents a model-based computationally efficient method for detecting milling chatter in its incipient stages and for chatter frequency estimation by monitoring the cutting force signals. Based on a complex exponentials model for the dynamic chip thickness, the chip regeneration effect is amplified and isolated from the cutting force signal for early chatter detection. The proposed method is independent of the cutting conditions. With the aid of a one tap adaptive filter, the method is shown to be capable of distinguishing between chatter and the dynamic transients in the cutting forces arising from sudden changes in workpiece geometry and tool entry/exit. To facilitate chatter suppression once the onset of chatter is detected, a time domain algorithm is proposed so that the dominant chatter frequency can be accurately determined without using computationally expensive frequency domain transforms such as the Fourier transform. The proposed method is experimentally validated. (65 refs, 20 figs, 1 table) (AA)

109690 Orthogonal microcutting of thin workpieces

Kushendarsyah, Saptaji; Sathyan, Subbiah [J of Manufacturing Sci & Engg:ASME Trans, v 135, n 3, Jun 2013, Starting Page 031004-1, Pages 11] With a broader intention of producing thin sheet embossing molds, orthogonal cutting experiments of thin workpieces are conducted. Challenges in machining thin workpieces are many: machining induced stress and deformation, fixturing challenges, and substrate effects. A setup involving continuous orthogonal cutting with a single crystal diamond tool of an aluminum alloy (Al6061-T6) workpiece fixtured using an adhesive to reduce its thickness is used to study trends in forces, chip thickness, and to understand to what level of thickness we can machine the workpiece down to and in what form the adhesive fails. There are no significant changes observed in the
forces and chip thickness between thick and thin workpieces during the experiments, meaning that the cutting energy required is the same in cutting thick or thin workpieces. The limitation to achieve thinner workpiece is attributed mainly due to the detachment of the thin workpiece by peel-off induced by adhesive failure mode, which occurs during initial chip formation as the tool initially engages with the workpiece. We use a finite element model to understand the stresses in the workpiece during this initial tool engagement when it is thick and when it is thin, as well as the effect of the adhesive itself and the effect of adhesive thickness. Simulation results show that the tensile stress induced by the tool at the workpiece-adhesive interface is higher for a thinner workpiece than a thicker workpiece and higher at the entrance. As such, a thinner workpiece is more susceptible to peel-off. The peeling of thin workpiece is induced when the high tensile stress at the interface exceeds the tensile-at-break value of the adhesive. (46 refs, 15 figs, 5 tables) (AA)

109691 Finite element-based study of the mechanics of microgroove cutting
Bourne, Keith A; Kapoor, Shiv G; DeVor, Richard E \( [J \textit{of Manufacturing Sci \& Engg: ASME Trans, v 135, n 3, Jun 2013, Starting Page } 031017-1,\) Pages 8] In this paper, 3D finite element modeling of this cutting process is used to better understand process mechanics. The development of the model, including parameter estimation and validation, is described. Validation experiments show that on average the model predicts side burr height to within 2.8%, chip curl radius to within 4.1%, and chip thickness to within 25.4%. The model is used to examine chip formation, side burr formation, and exit burr formation. Side burr formation is shown to primarily occur ahead of a tool and is caused by expansion of material compressed after starting to flow around a tool rather than becoming part of a chip. Exit burr formation is shown to occur when a thin membrane of material forms ahead of a tool and splits into two side segments and one bottom segment as the tool exits a workpiece. (23 refs, 13 figs, 8 tables) (AA)

109692 Effect of reciprocating wire slurry sawing on surface quality and mechanical strength of as-cut solar silicon wafers
Wu, Hao; Yang, Chris; Melkote, Shreyes N \( [\textit{Precision Engg, v 38, n 1, Jan 2014, Starting Page } 121,\) Pages 6] Investigates reciprocating wire slurry sawing for photovoltaic (PV) silicon wafering and compares the resulting wafer surface quality and its mechanical strength to that obtained in unidirectional wire sawing. It is found that wire reciprocation creates two significantly different morphological or cutting zones on the wafer surface. The zone width varies with the distance travelled by the wires, the cutting location on the wafer surface, and direction of wire motion. In general, results suggest a higher material removal rate during forward motion of the wire than during backward motion. Notwithstanding the surface morphology variations, the fracture strengths of reciprocating wire sawn wafers are found to be quite similar to that exhibited by wafers produced by unidirectional wire sawing. (15 refs, 10 figs, 2 tables) (GM)

109693 Modelling of surface finish and material removal rate in rough honing
Buj-Corral, Irene; Vivancos-Calvet, Joan; Coba-Salcedo, Milton \( [\textit{Precision Engg, v 38, n 1, Jan 2014, Starting Page } 100,\) Pages 9] Present work influence of different parameters of the rough honing process on surface roughness and material removal rate were studied. Specifically, second order mathematical models are presented for mean average roughness \( \bar{R}/ \) (\( \mu \text{m} \)), maximum peak-to-valley roughness \( \text{RT} \) (\( \mu \text{m} \)) and material removal rate \( \text{Qm} \) (\( \text{cm min}^{-1} \)), obtained by means of regression analysis. From the models most influential factors on process quality as well as on productivity were determined. Within the range studied, roughness depends mainly on grain size, pressure and density of abrasive. Material removal rate depends on grain size and pressure, followed by tangential speed. Optimization by means of the desirability function technique allowed determining most appropriate conditions to minimize roughness (surface quality) and/or maximize material removal rate (productivity). (20 refs, 5 figs, 6 tables) (GM)

109694 Machinability study of high speed steel for focused ion beam (FIB) milling process – An experimental investigation at micron/nano scale
Bhavsar, Sanket N; Aravindan, S; Venkateswara Rao, P \( [\textit{Precision Engg, v 38, n 1, Jan 2014, Starting Page } 168,\) Pages 6] Nowadays the attention is focused on machining of non-silicon materials for miniaturized devices. High speed steel (HSS) is a non-silicon tool material, which is used in metal cutting applications as well as in micro-medical applications. Focused ion beam (FIB) milling process is highly suited for the fabrication of micro tools and other micro devices manufactured from HSS material. This study investigates the machinability aspects of HSS for FIB milling process. Beam current, extraction voltage, angle of incidence,
Abstracts
dwell time and percentage overlap between beam diameters are the FIB process parameters, which have been analyzed experimentally to optimize FIB milling process for maximum material removal rate and minimum surface roughness. Beam current is found as the most significant parameter for controlling the material removal rate and surface roughness. (23 refs, 7 figs, 4 tables) (AA)

109695 Novel approach to fixture layout optimization on maximizing dynamic machinability
Wan, Xiao-Jin; Zhang, Yan [Int J of Machine Tools & Manufacture, v 70, Jul 2013, Starting Page 32, Pages 13] In the aerospace industry, the reasonable layout of fixture can efficiently suppresses machining vibration of thin-walled aerospace structure during machining. Based on the analysis of typical structural components encountered in the aerospace industry, a general frame-structure workpiece with fixture constraints can be equivalent as Mindlin plates with simultaneous elastic edges and internal supports. On basis of the equivalent models, the powerful pb-2 Ritz method defined by the product of a two-dimensional polynomial and basic functions can be introduced to be taken as trial functions. Substituting displacement functions into energy functional and minimizing total energy by differentiation leads to eigenfrequency equations of the workpiece–fixture system. Consequently, a novel nonlinear programming problem based on the frequency sensitivity can be built to optimize the layout of fixture supports to maximize the fundamental nature frequency of the workpiece–fixture system. The feasibility of the proposed approach is validated by a machining case. (21 refs, 8 figs, 3 tables) (AA)

109696 Investigation of thermal effects on machining chatter based on FEM simulation of chip formation
Mohammad, S; Hajmohammadi; Mohammad, R; Movahhedy; Moradi, Hamed [CIRP J of Manufacturing Science and Technology, v 7, n 1, 2014, Starting Page 1, Pages 10] In this paper, thermo mechanical finite element analysis of orthogonal machining process with thermo-mechanical coupling effects, i.e., interactions between the stress state, strain rates and the temperature softening of material in the plastic deformation zone, is proposed to predict cutting temperature distribution in the cutting zone. The feasibility and prediction accuracy of the model is verified by experimental measurements through Thin Film Thermocouple (TFTC) arrays embedded at the immediate vicinity of the cutting zone into Polycrystalline Cubic Boron Nitride (PCBN) tooling. The experimental verification is performed under hard turning conditions. It has been shown that the predictions of the proposed model are in very close agreement with the experimentally measured results including the cutting forces, chip thickness and cutting temperature distributions on the rake and flank faces in the cutting zone. Furthermore, the modeling results have also provided an essential understanding on the stress distributions at the tool/chip and work/tool interfaces as well as of the nature of the chip flow velocity along the rake face of the cutting tool. (33 refs, 17 figs, 1 table) (AA)

109698 Experimental optimization of micro-electrical discharge drilling process from the perspective of inner surface enhancement measured by shear-force microscopy
Rashed, CAA; Romoli, L; Tantussi, F; Fusco, F; Bertoncini, L; Fiaschi, M; Allegrini, M; Dini, G [CIRP J of Manufacturing Science and Technology, v 7, n 1, 2014, Starting Page 11, Pages 9] The micro-electrical discharge drilling process was studied by means of experiments with the twofold
objective of increasing the surface quality while minimizing the drilling time. To characterize the inner surface of micro-drilled holes obtained by EDM a specifically conceived scanning probe microscopy technique was used. Discharge current and pulse duration were used as input parameters with the aim of quantifying the effects of applied spark energies on surface characteristics. 150 µm diameter holes were drilled using combinations of process parameters defining spark energies within the range of 3.25 µJ and 15 µJ. Results showed that the surface texture can be characterized by (i) maximum peak-to-valley distance and (ii) periodicity whose dimensions were related to the adopted spark energy. Standard Rq derived from the measured cylindrical surfaces was found to vary between 240 nm and 380 nm. Experiments testified that removal rates higher respect to those commonly used in industry can be adopted when followed by a lateral erosion phase at low energy which reduces Rq of 32% without changing the drilling time. (22 refs, 12 figs, 3 tables) (AA)

109701 Deposition of bronze-nickel on steel by laser-based metal deposition process
Vinod, AR; Srinivasa, CK; Keshavamurthy, R; Shashikumar, PV [Manufacturing Technology Today, v 13, n 1, Jan 2014, Starting Page 27, Pages 4] Direct Metal Deposition (DMD) is an additive manufacturing process for fabrication of metal parts directly from CAD model using high power lasers as heat source. In this paper, bronze-nickel material was deposited on steel substrate by DMD process. Laser power was varied from 100 to 300 W in steps of 50. Laser scan speed, powder flow rate, nozzle stand-off and step-over were maintained at 165 mm/min, 1.2 g/min, 10 mm and 0.15 mm respectively. Laser power had a significant influence on the quality of joint between bronze nickel and steel. (13 refs, 8 figs) (AA)
6) A Plasma based high current focused ion beam (FIB) system to produce micron size ion beams of all gaseous elements has been indigenously developed. The system is capable of delivering ion currents in the focused spot in the range of few nA to 2.5 µA and the ion source delivers ion current with angular current density of more than 20 mA/Sr. These parameters are atleast three orders larger than conventional FIB systems utilizing LMIS. Few ion beam milling experiments on steel and silicon show the milling rate of about 300µm³/s. (10 refs, 5 figs, 1 table) (AA)

109704 Enhancement of surface quality in ultrasonic machining of glass using a sacrificing coating
Baek, Dae Kyun; Ko, Tae Jo; Yang, Seung Han [J of Materials Processing Technology, v 213, n 4, Apr 2013, Starting Page 553, Pages 7] Present a new fabrication method that enables precision hole machining to be achieved by sacrificing the coating on the substrate in ultrasonic machining (USM). A hard wax coating is deposited on the glass substrate, and holes are precisely fabricated in the coated glass using USM. Finally, a wax coating is removed using a cleaning process. The wax coating protects the surface of the glass so that cracks are generated in the wax rather than on the surface. The surface accuracy of the glass substrate is evaluated at the hole entrance using the new tools in USM as a function of the thickness of the coating. The entrance diameters of the machined holes and the machining forces at the beginning of cutting are measured as a function of the thickness of the coating. The entrance cracks and out-of-roundness of the machined holes are generated in the sacrificed coating on the glass substrate; hence, the surface quality of the glass holes is enhanced in USM. (11 refs, 12 figs, 2 tables) (AA)

109705 Micro-EDM: system and its applications
Rahman, M; Asad, ABMA; Nguyen, MD; Masaki, T; Jahan, MP; Saleh, T; Wong, YS [Manufacturing Technology Today, v 13, n 2, Feb 2014, Starting Page 3, Pages 20] Micro-EDM, a non-conventional machining process, is one of the most promising tool based micromachining technique which has the capability to machine micro-components with almost negligible amount of cutting force. Recent applications of micro-EDM process are increasing at an impressive rate and an explicit outcome of multidisciplinary research effort on the subject matter. This paper presents an overview of micro-EDM technology and some of the recent applications. (71 refs, 24 figs) (AA)

109706 Advances in metal additive processes
Jyotirmoy Mazumder; Lijun Song [Manufacturing Technology Today, v 13, n 1, Jan 2014, Starting Page 3, Pages 23] Breinan and Kear first reported fabrication of three-dimensional metallic components via layer by layer laser cladding in 1978 and subsequently a patent was issued to Brown et al. in 1982. Recently, various groups are working world wide on different types of layered manufacturing techniques for fabrication of near net shape metallic components. Integration of lasers with multi-axis presently available CNC machines, CAD/CAM, sensors and powder metal delivery through co-axial nozzles along with the laser beam are the main innovations for fabrication of 3-Dimensional components. Continuous corrective measures during the manufacturing process are necessary to fabricate net shape functional parts with close tolerances and acceptable residual stress. The closed loop Direct Metal Deposition (DMD) System, using an optical feedback loop along with a CNC working under the instructions from a CAD/CAM software, indicate that it can produce three dimensional components directly from the CAD data eliminating intermediate machining and reduces final machining considerably. This technology is now being commercialized. The closed loop DMD process ensure close dimensional tolerance and enables fabrication of components with multiple materials. A mold flow analysis revealed that an injection-molding die with conformal cooling and Copper heat sink can reduce the cycle time up to 50% or more. DMD has already demonstrated the capability of fabricating 3-D 100% dense metal components with functional design. Popular engineering alloys such as H13 and S7 tool steels, Stellite 21 and 6 Cobalt alloys, Nickel alloys such as Inconel 718 are already reported in the literature. DMD can be adapted directly to the digital data from CAD, MRI and X-ray tomography. Conceptually, DMD is capable of fabricating almost wide variety of metallic parts with internal features. This paper critically reviews the state of the art of DMD and also speculates how DMD may affect manufacturing technology in the future. Four areas appear to be most promising to the author are:

1) Designed Materials: This capability can be utilized to create a new class of optimally “Designed Materials” — a class of artificial materials with properties and functions, which do not exist now. In other words, a material system can be designed and fabricated for a chosen performance.
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2) Integrated Design and Manufacturing: Another potential impact of closed loop Direct Materials Deposition is integration of design and manufacturing. In the integrated approach, customer performance desire can be implemented during design concept stage to the manufacturing realization. This will not only reduce the lead-time for the concept to product but also will offer materials with properties and functions, which do not exist now.

3) In Situ Diagnostics: Metal Additive processes generally produce light and plasma, which can be utilized to monitor the health of the process in situ. In –situ information can be utilized for feedback loop which controls the thermal cycle. New Sensors are either developed or being developed to control geometry.

4) Remote Manufacturing: Modern communication methods are improving the Internet’s capability to transfer large volume of data in a relatively short time. Mathematical and optical methods of data compression are enhancing this capability even further. This will enable seamless communication between design and manufacturing teams in industry. It is conceivable that a design team can send their design data electronically and observe the fabrication from a remote site and even edit it on line. of course, to realize this scenario, synthesis and enhancement of various technologies are needed. (102 refs, 24 figs, 3 tables) (AA)

109707 Study of EDM cutting of single crystal silicon carbide
Zhao, Yonghua; Kunieda, Masanori; Abe, Kohzoh [Precision Engg, v 38, n 1, Jan 2014, Starting Page 92, Pages 8] Electrical discharge machining (EDM) is developing as a new alternative method for slicing single crystal silicon carbide (SiC) ingots into thin wafers. Aiming to improve the performance of EDM slicing of SiC wafers, the fundamental characteristics of EDM of SiC single crystal were experimentally investigated in this paper and compared to those of steel. Furthermore, EDM cutting of SiC ingot by utilizing copper foil electrodes was proposed and its performance was investigated. It is found that the EDM characteristics of SiC are very different from those of steel. The EDM machining rate of SiC is higher and the tool wear ratio is lower compared to those of steel, despite SiC having a higher thermal conductivity and melting point. Thermal cracks caused by the thermal shock of electrical discharges and the Joule heating effect due to the higher electrical resistivity are considered to be the main reasons for the higher material removal rate of SiC. It is concluded that the new EDM cutting method utilizing a foil electrode instead of a wire electrode has potential for slicing SiC wafers in the future. (9 refs, 18 figs, 7 tables) (AA)

**DIAMOND TURNING**

109708 Theoretical and experimental investigation into five-DOF dynamic characteristics of an aerostatic bearing spindle in ultra-precision diamond turning
Zhang, SJ; To, S; Wang, HT [Int J of Machine Tools & Manufacture, v 71, Aug 2013, Starting Page 1, Pages 10] In this study, mathematical solutions for a proposed five-degree-of-freedom (FDOF) dynamic model of an aerostatic bearing spindle are derived to explore natural mechanisms of spindle vibration. Thus, the potential benefits of the solutions are to be applied for the prediction and optimization of the effects of spindle vibration on surface generation. Its dynamic characteristics possess three translational frequencies along the radial and axial directions, a spindle rotational frequency (SRF), and a pair of coupled tilting frequencies (CTFs) around the radial directions influenced the SRF. The theoretical results are identified by the frequency characteristics of thrust cutting forces, and the periodic, concentric, spiral, radial and two-fold patterns (PCSRPs) of the machined and simulated surface topographies, respectively. (15 refs, 7 figs, 2 tables) (GM)

**LASER MACHINING**

109709 Energy input effect on morphology and microstructure of selective laser melting single track from metallic powder
Yadroitsév, I; Krakhmalev, P; Yadroitsava, I; Johansson, S; Smurov, I [J of Materials Processing Technology, v 213, n 4, Apr 2013, Starting Page 606, Pages 8] In this research, influence of the energy input parameters on microstructure and geometry of single tracks fabricated of stainless steel grade 316L powder was analysed. Both factors were found statistically significant with regard to their influence on the remelted depth and the primary cell spacing in the colonies observed in the tracks cross-sections. More specifically, the contact angle and track height were controlled by the preheating temperature, and track width and contact zone characteristics were governed by the laser scanning speed. Conclusions regarding the selection of process parameters for...
the formation of tracks with the desired geometry and microstructure were formulated based on statistical analysis of the experimental data. (25 refs, 8 figs) (GM)

**LASER SINTERING**

**109710** Surface roughness analysis, modelling and prediction in selective laser melting

Strano, Giovanni; Hao, Liang; Everson, Richard M; Evans, Kenneth E [J of Materials Processing Technology, v 213, n 4, Apr 2013, Starting Page 589, Pages 9] In this study an investigation of surface roughness and morphology is presented for Steel 316L alloy parts made by SLM. In order to characterise the actual surfaces at different sloping angles, truncheon samples have been produced and an analysis has been conducted at different scales, by surface profilometer and scanning electron microscope (SEM). The surface analysis has showed an increasing density of spare particles positioned along the step edges, as the surface sloping angle increases. When layer thickness is comparable to particle diameter, the particles stuck along step edges can fill the gaps between consecutive layers, thus affecting the actual surface roughness. The paper investigates the key contributing factors influencing surface morphology, and a theoretical model for roughness prediction that provides valuable information to improve the surface quality of SLM parts, thus minimising the need of surface finishing. (22 refs, 16 figs, 1 table) (GM)

**MANUFACTURING SYSTEMS**

**109711** Development of a novel process planning algorithm for an unconstrained hybrid manufacturing process

Zhu, Zicheng; Dhokia, Vimal; Newman, Stephen T [J of Manufacturing Processes, v 15, n 4, Oct 2013, Starting Page 404, Pages 10] In this paper, a hybrid process, entitled iAtractive, combining additive, subtractive and inspection processes, along with part specific process planning is proposed. The iAtractive process aims to accurately manufacture complex geometries without being constrained by the capability of individual additive and subtractive processes. This process planning algorithm enables a part to be manufactured taking into consideration, process capabilities, production time and material consumption. This approach is also adapted for the remanufacture of existing parts. Four test parts have been manufactured from zero and existing parts, demonstrating the efficacy of the proposed hybrid process and the process planning algorithm. (32 refs, 11 figs, 1 table) (AA)

**MEASUREMENT & TESTING**

**109712** Manufacturing metrology and sensing for quality

Radhakrishnan, V [Manufacturing Technology Today, v 13, n 4, Apr 2014, Starting Page 4, Pages 9] Metrology and inspection are logically associated with product quality in manufacturing. Quality from a conceptual angle has undergone many changes over the years. Initially it was associated with inspection and later on covered the areas of process control, quality assurance, total quality management and strategic quality management. In the first two phases, i.e. inspection and process control, quality was mostly confined to shop floor activities. The concept of quality assurance took care of the design aspects also into account. A wider coverage involving the people and the system brought out the Total Quality Management concept. A further step, based on the definition of quality as the fitness for the purpose as seen by the customer, brought out the concept of Strategic Quality Management encompassing the quality of the product throughout its life. Thus the concept of quality today covers many angles of the product right from its concept to final disposal at the end of its life. The important step towards realising the product quality is even now taken at the shop floor level and will continue to be so. Hence product inspection and process control will continue to play a crucial role in our quality efforts. Further, the condition of the process is closely related to the quality it delivers. By monitoring the product quality through changes taking place on the part i.e. dimension finish and geometrical form, it is possible to assess the condition of the process. Manufacturing metrology plays an important role in this. Approaches towards this have changed considerably over the years. Technological innovations have allowed manufacturing metrology to meet the challenges posed by diminishing tolerances, demand for ultra fine finish, closer form adherence and advanced concepts in condition monitoring. This article deals with the trends in the development in this area, present status and future outlook. It deals in detail on the technology available currently and explores areas of research and development to meet future needs. (12 refs, 15 figs) (AA)
109713 Manufacturing in the eyes of a metrologist
Prof. Shunmugam, MS [Manufacturing Technology Today, v 13, n 4, Apr 2014, Starting Page 13, Pages 5] General perception among the engineering students, researchers and practitioners is that metrology activities find place in the chain of design-manufacturing-metrology activities only to verify a manufactured component and check its conformance to the design specification. This keynote paper is intended to bring out the intricacies in the manufacture of engineering components, deviating from the above conventional chain. A sincere attempt is made in this keynote paper to emphasize the fact that a metrologist is not only a person familiar with the science and application of etrology, but also having an eye for the details. The chosen topic is so wide in its scope that an account of author’s own experience is presented here to mainly serve as a starter. (9 refs, 4 figs) (AA)

109714 Measurement and verification of position-independent geometric errors of a five-axis machine tool using a double ball-bar
Lee, Kwang-Ii; Yang, Seung-Han [Int J of Machine Tools & Manufacture, v 70, Jul 2013, Starting Page 45, Pages 8] In this study, position-independent geometric errors, including offset errors and squarness errors of rotary axes of a five-axis machine tool are measured using a double ball-bar and are verified through compensation. In addition, standard uncertainties of measurement results are calculated to establish their confidence intervals. This requires two measurement paths for each rotary axis, which are involving control of single rotary axis during measurement. So, the measurement paths simplify the measurement process, and reduce measurement cost including less operator effort and measurement time. Set-up errors, which are inevitable during the installation of the balls, are modeled as constants. Their effects on the measurement results are investigated to improve the accuracy of the measurement result. A novel fixture consisting of flexure hinges and two pairs of bolts is used to minimize set-up error by adjusting the ball’s position located at the tool nose. Simulation is performed to check the validation of measurement and to analyze the standard uncertainties of the measurement results. Finally, the position-independent geometric errors of the five-axis machine tool (involving a rotary axis and a trunnion axis) are measured using proposed method. (25 refs, 12 figs, 4 tables) (AA)

109715 Temperature measurement of cutting tool and machined surface layer in milling of CFRP
Yashiroa, Takeshi; Ogawab, Takayuki; Sasaharac, Hiroyukia, Takeshi; Ogawab, Takayuki; Sasaharac, Hiroyuki [Int J of Machine Tools & Manufacture, v 70, Jul 2013, Starting Page 63, Pages 7] The measurement of cutting temperature is important when dealing with carbon fiber-reinforced plastics (CFRPs). Temperatures higher than the glass-transition temperature of the matrix resin are not favorable as they damage the CFRP. In this research, the cutting temperature in the endmill machining process was measured using three methods. The measured cutting point temperature exceeded the glass-transition temperature. However, the influence of temperature elevation at the cutting point could be reduced by taking a suitable distance from the machined surface depending on the cutting speed. In addition, observation of the machined surface with SEM revealed that the matrix resin at the machined surface was not damaged even if the cutting speed was over 300 m/min. This phenomenon depends on the low thermal conductivity of the CFRP. Therefore, high-speed cutting is applicable for the milling of CFRP. (19 refs, 15 figs, 3 tables) (AA)

109716 Analysis of error motions of ultra-high-speed (UHS) micromachining spindles
Anandan, K Prashanth; Ozdoganlar, O Burak [Int J of Machine Tools & Manufacture, v 70, Jul 2013, Starting Page 1, Pages 14] Presents an experimental approach to analyze radial and axial error motions of miniature ultra-high-speed (UHS) spindles. The present work focuses on identifying the sources of error motions and quantifying them, specifically for the UHS spindles with hybrid ceramic bearings. In this work, a laser Doppler vibrometer (LDV)-based measurement technique is used to measure radial and axial motions of the spindle from a sphere-on-stem precision artifact. The influence of temperature fluctuations, dynamically-induced effects, contact-bearing defects, and tool-attachment errors are analyzed. The variations arising from tool attachment to the collet are also studied. It is seen that (1) the thermal state of the spindle exhibits a cyclic behavior that results in significant changes to the spindle motions, (2) spindle speed and over-hang length significantly affect the spindle motions, and (3) the variations arising from the tool attachment to the collet can be described using a normal distribution, and may cause more than ±50% amplitude variations to the spindle motions. (46 refs, 18 figs, 2 tables) (GM)
Abstracts

109717 Machine vision for metrology applications
Usha, S; Shashi Kumar, PV [Manufacturing Technology Today, v 13, n 4, Apr 2014, Starting Page 26, Pages 4] Conventional coordinate measuring machine poses problem for handling delicate components. Optical profile projectors require enormous time for manual cursor positioning to make measurements. A separate setup is called for inspecting the surface finish (microscope). These issues are addressed by a single setup using vision techniques for both precision measurements as well as to identify surface defects. This paper discusses about machine vision technique for metrology requirement and explain how ‘Vision for Metrology’ differs in terms of sensor requirement, lighting techniques, calibration methods and algorithm from a conventional vision system used for feature identification, recognition etc. (4 figs) (AA)

109718 Dynamic characterization of multi-axis dynamometers
Korkmaz, Emrullah; Bediz, Bekir; Gozen, B Arda; Ozdoganlar, O Burak [Precision Engg, v 38, n 1, Jan 2014, Starting Page 148, Pages 14] Presents a comprehensive technique for accurate determination of three-dimensional (3D) dynamic force measurement characteristics of multi-axis dynamometers within a broad range of frequencies. Many research and development efforts in machining science and technology rely upon being able to make precise measurements of machining forces. In micromachining and high-speed machining, cutting forces include components at frequencies significantly higher than the bandwidth of force dynamometers. Further, the machining forces are three-dimensional in nature. Presents a new experimental technique to determine the three-dimensional force-measurement characteristics of multi-axis dynamometers. A custom-designed artifact is used to facilitate applying impulsive forces to the dynamometer at different positions in three dimensions. The presented technique provides a foundation for future compensation efforts to enable measuring forces within a broad range of frequencies. (34 refs, 13 figs, 3 tables) (GM)

109719 Machining assessment of nano-crystalline hydroxyapatite bio-ceramic
Kulkarni, Sanket S; Yong, Yaowei; Rys, Malgorzata J; Lei, Shuting [J of Manufacturing Processes, v 15, n 4, Oct 2013, Starting Page 666, Pages 7] This study investigates the machinability of nano-crystalline HAP (nHAP) bio-ceramic in end milling operations, using uncoated carbide tool under dry cutting conditions. Efforts are focused on the effects of various machining conditions on surface integrity. A first order surface roughness model for the end milling of nHAP was developed using response surface methodology (RSM), relating surface roughness to the cutting parameters: cutting speed, feed, and depth of cut. Model analysis showed that all three cutting parameters have significant effect on surface roughness. However, the current model has limited statistical predictive power and a higher order model is desired. Furthermore, tool wear and chip morphology was studied. Machined surface analysis showed that the surface integrity was good, and material removal was caused by brittle fracture without plastic flow. (13 refs, 10 figs, 3 tables) (AA)

109720 Addressing the environmental challenges of Nanometrology Laboratories
Prakash Vinod, Girish Kumar, M; Shashikumar, PV [Manufacturing Technology Today, v 13, n 4, Apr 2014, Starting Page 18, Pages 8] Nanometrology deals with measurements and analysis of dimensions of approximately 1 to 100 nanometres as well as measurement of force, electrical, magnetic and optical properties and to correlate the measured size with properties. Some aspects of this work require extremely stable environments. Very stringent limits are often required on environmental vibration and noise, temperature, EMC, Illumination and Clean Room requirements. The environmental requirements of Nanometrology from the perspective of designing of an advanced Nanometrology laboratory are studied and reviewed in this paper. A desirable environment at a site may be adversely affected by ground vibration from a variety of sources such as road traffic, metro train movements, utility plants and the construction. The environment inside the lab is also affected by temperature fluctuation, humidity, acoustics disturbances, air velocity, EMC, Illumination and cleanliness. All these factors affect the nano level measurements. This paper addresses various environmental conditions, its potential effect on nano level measurements and environmental conditions to be maintained for a nano metrology laboratory. (22 refs, 10 figs, 3 tables) (AA)
Abstracts

109721 Nano-patterning of 16-MHA over palladium substrate using dip-pen nanolithography (DPN)
Amit Kumar Goyal and Pankaj B Agarwal [Manufacturing Technology Today, v 13, n 3, Mar 2014, Starting Page 13, Pages 7] In this paper, the nanowriting process over palladium substrate with 16-MHA ink has been established using Dip-Pen Nanolithography. For nanowriting, the substrate was fabricated with very low rms roughness (~0.64nm) using e-beam deposition technique. After ink calibration, the lines and dots were fabricated with 5mM ink of 16-MHA. The width/diameter estimation of patterns was done in NanoRule image analysis software. The effect of humidity along with varying speed/dwell time is also demonstrated and results are explained in detail. The measured minimum line width ~269nm and dot diameter ~602 nm was successfully achieved. These SAM patterns could be very useful for positioning of carbon nanotubes (CNTs). The low contact resistance of Pd with CNTs would also be an additional advantage. (11 refs, 8 figs) (AA)

109722 Enhanced emission properties of carbon nanoparticles by hydrothermal method
Murugan, A; Ramesh, R; Shashikumar, PV [Manufacturing Technology Today, v 13, n 3, Mar 2014, Starting Page 20, Pages 4] Presents on a multi-color fluorescent and water soluble carbon nanoparticle (CNPs) were fabricated by a facile one-step hydrothermal method by using L-Ascorbic Acid as a carbon source. Height distribution of Atomic Force Microscope (AFM) image reveals CNPs are monodisperse having average size of 5.0nm with narrow distribution. Raman analysis shows, as synthesized CNPs having sp2 hybridization of carbon having graphite crystalline structure. The CNPs could emit bright and colorful photoluminescence (PL) which covering the entire visible to Near Infrared (NIR) spectral range. Moreover, these particles also had excellent up conversion fluorescent properties over the range. (15 refs, 6 figs) (AA)

109723 The effects of spindle vibration on surface generation in ultra-precision raster milling
Zhang, SJ; To, S: [Int J of Machine Tools & Manufacture, v 71, Aug 2013, Starting Page 52, Pages 5] In this study, a specialized model for an aerostatic bearing spindle under the impulsive excitation from intermittent cutting forces of UPRM is developed and its derived mathematical solutions reveal that the spindle vibration is impulsive response. The theoretical and experimental results signify that the impulsive spindle vibration produces inhomogeneous scallops forming ribbon-stripe patterns and irregular patterns like run-out on a surface of UPRM. The potential benefits for UPRM are the theoretical supports for optimization and prediction of surface generation through the optimal selection of spindle speed. (11 refs, 2 figs, 1 table) (GM)

109724 Characterization of grinding wheel topography using a white chromatic sensor
Darafon, Abdalslam; Warkentin, Andrew; Bauer, Robert [Int J of Machine Tools & Manufacture, v 70, Jul 2013, Starting Page 22, Pages 10] This paper introduces a non-contact, non-destructive three-dimensional wheel scanning system which is capable of measuring and characterizing the surface topography of grinding wheels. The scanning system employs a white light chromatic sensor that traverses across the wheel surface using motorized stages controlled by a computer. With a planer resolution of 2 µm and a depth resolution of 25 nm, the novel scanning system was shown to compare well with a HITACHI S-4700 Scanning Electronic Microscope and a Nanovea PS50 profiler for measuring a 60 grit aluminum oxide grinding wheel—without having to destroy the grinding wheel to take the measurements. It was shown that image processing techniques, including segmentation and “blob” analyses, were able to extract the cutting edge density, width, spacing and protrusion height from the raw topography measurements. The wheel scanning system was then used to characterize the surface of a grinding wheel that had been dressed using motorized stages controlled by a computer. Furthermore, for the dressing conditions used in this research, it was observed that dressing noticeably affected the grinding wheel surface to a depth of 80 µm, while grain geometry and spacing dominated the surface topography beyond this depth. (18 refs, 17 figs, 1 table) (AA)
PRODUCT DESIGN & MANUFACTURE

109725 Design, manufacturing, and performance verification of a Roberts linkage for inertial isolation
Bosetti, Paolo; Biral, Francesco; Bortoluzzi, Daniele [Precision Engg, v 38, n 1, Jan 2014, Starting Page 138, Pages 10] The present work discusses the optimal design, realization, and testing of an inertial isolation system implemented as a 3-D Roberts linkage. The first part of the work describes the design phase: the optimal calculation of the linkage design parameters is performed through the application of a Nelder–Mead optimization scheme. In order to apply the optimization scheme, the calculation of the linkage kinematics is firstly performed through a variational approach, then the sampled surface describing the linkage trajectory is approximated by a set of Zernike polynomials, which allows to effectively define and calculate the target function for the optimization itself. The second part of the work describes the detailed design and realization of a linkage prototype, and its characterization by means of a coordinate measuring machine. The characterization of the device is carried out by exploiting a coordinate measuring machine, which is unusually employed for both driving the linkage moveable part along its two DoF trajectory, and for measuring the resulting error about the nominal trajectory. (28 refs, 8 figs, 3 tables) (GM)

QUALITY MANAGEMENT

109726 Finding the most favorable orientation of a part using stability method
Suresh, M; Jagadeesh, KA [Manufacturing Technology Today, v 13, n 2, Feb 2014, Starting Page 23, Pages 4] During the recent years, manufacturing industries have been functioning under the globally competitive environment. Hence these industries are required to enhance their performance to offer world class quality products and services in a shorter time period. Part feeder is used in automated assembly lines to segregate and orient parts prior to packing. Linear Feeders are specially designed as an alternative to vibratory bowl feeders and involve horizontal conveying of components. Obtaining a particular orientation of a part in assembly station is a tedious task in a shorter lead time. To overcome this problem, part feeding system is used to segregate and orient parts prior to assembly. Before designing the part feeders, the most favorable orientation of part should be identified. The most favorable orientation of part is found using stability method. In this work, the most favorable orientation of a typical asymmetric component, brake pad, is identified. (6 refs, 6 figs, 1 table) (AA)

ARTIFICIAL INTELLIGENCE & ROBOTICS

109727 Error modeling and sensitivity analysis of a hybrid-driven based cable parallel manipulator
Zi, Bin; Ding, Huafeng; Wu, Xia; Kecskeméthy, Andrés [Precision Engg, v 38, n 1, Jan 2014, Starting Page 197, Pages 15] Deals with the error modeling and sensitivity analysis of a hybrid-driven based cable parallel manipulator (HDCPM). The HDCPM has the advantages of both cable parallel manipulator and hybrid-driven planar five-bar mechanism. Kinematics analysis and error modeling are performed based on closed loop vector conditions and direct differential method. A detailed example of the sensitivity of the end-effector’s position coordinates for the HDCPM is presented in order to demonstrate the validity of the error modeling and sensitivity analysis developed. (37 refs, 37 figs, 4 tables) (GM)

TOOLS AND TOOLING

109728 Dicing of hard and brittle materials with on-machine laser-dressed metal-bonded diamond blades
Witzendorff, Philipp von; Stompe, Manuel; Moalem, Anas; Cveticovic, Sreko; Suttmann, Oliver; Overmeyer, Ludger; Rissinger, Lutz [Precision Engg, v 38, n 1, Jan 2014, Starting Page 162, Pages 6] In this study, the laser dressing of metal-bonded diamond blades is investigated to enable their use in the ultra-precision dicing of hard and brittle materials by continuous laser dressing. Investigates laser dressing with and without the presence of cooling water. The sharpness (grain exposure) after dressing is measured by the cutting face surface roughness. The dicing performance is evaluated by observing the dicing results in terms of cutting depth consistency and by monitoring the spindle power during dicing. Dicing blades which have been laser dressed in an environment with coolant feature less grain exposure than dicing
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blades which have been laser dressed in dry condition. The dicing results show an improvement in the sharpness and durability of laser-dressed dicing blades in comparison with new or conventionally dressed blades. The ability to apply and perform laser dressing on a dicing machine in an environment with coolant shows the feasibility of laser technology for continuous dressing. (16 refs, 8 figs, 1 table) (AA)

109729 Improving machining performance of single-crystal diamond tools irradiated by a focused ion beam
Kawasegi, Noritaka; Niwata, Tomoyuki; Morita, Noboru; Nishimura, Kazuhiro; Sasaoka, Hideki [Precision Engg, v 38, n 1, Jan 2014, Starting Page 174, Pages 9] Tool shape is an important factor determining the shape and accuracy of machined areas in ultra-precision machining. Use of a focused ion beam (FIB) is an effective means to fabricate micro- to submicro-scale tool shapes. However, ion irradiation causes doping and defects in the tool that reduce tool performance. To use FIB machining on a single-crystal diamond tool without degrading tool performance, a combination of 500 °C heat treatment and aluminum deposition was used to remove gallium (Ga) ions induced by ion irradiation. The method was evaluated through machining experiments that showed that irradiation of Ga ions causes work materials to adhere to the tool surface. This adhesion and the resulting rapid tool wear were reduced by heat treatment. The proposed method also improved the transcription ability and wear resistance of the tool so it was capable of producing a surface quality better than or equal to that produced by non-irradiated tools, even over long cutting distances. (10 refs, 18 figs, 1 table) (AA)

109730 Study on machinability of a stellite alloy with uncoated and coated carbide tools in turning
Shao, H; Li, L; Liu, LJ; Zhang, SZ [J of Manufacturing Processes, v 15, n 4, Oct 2013, Starting Page 673, Pages 9] This study investigates the machinability of stellite 12 alloys with uncoated carbide cutting tool grades YG610 (K01-K10) and YT726 (K05-K10/M20) and SANDVIK coated carbide tool SNMG150612-SM1105 under dry cutting conditions. Both wear mechanisms and failure modes of the uncoated and coated tools were investigated with turning experiments. The results show that the coated tool SM1105 remarkably outperforms the uncoated tools; and the cutting tool YG610 generally outperforms YT726 under all cutting conditions. Built-up edge was found with YG610 in some cutting conditions and with SM1105 at cutting speed of 16 m/min. Tool surface burning marks were observed on YT726 at relatively higher cutting speeds. Wear develops slowly with coated tools SM1105 until VB reaches 0.2 mm at most conditions (except at v = 43 m/min, f = 0.25 mm/r). Excessive tool flank typically resulted in tool breakage at the cutting edge for uncoated tools. Abrasive and adhesive wear of cutting tools were observed at low cutting speeds while diffusion and chemical wear occurred at higher cutting speeds. (16 refs, 17 figs, 10 tables) (AA)

109731 Experimental and finite element simulation based investigations on micro-milling Ti-6Al-4V titanium alloy: Effects of cBN coating on tool wear
Thepsonthi, Thanongsak; Özel, Tugrul [J of Materials Processing Technology, v 213, n 4, Apr 2013, Starting Page 532, Pages 11] In this study an attempt to improve the performance of carbide micro-end mills by applying cubic boron nitride (cBN) coating was carried out. Experiments and finite element method (FEM) based simulations were used to study the effect of cBN coated tool in micro-machining of Ti-6Al-4V titanium alloy. The experiments were conducted to compare the performance of cBN coated and uncoated micro-end mills in terms of surface roughness, burr formation and tool wear. FE simulations were employed to investigate chip formation process in micro-milling to reveal the effects of cBN coated micro-end mills with increased edge radius in terms of cutting force generation, tool temperature and contact pressure, sliding velocity and hence tool wear rate. The simulation results were further utilized for estimating tool life using a sliding wear rate model and compared with experiments. This study clearly showed that the cBN coated carbide tool outperformed the uncoated carbide tool in generation of tool wear and cutting temperature. (20 refs, 25 figs, 2 tables) (GM)
Abstracts

Ganesa Balamurugan, K; Mahadevan, K [J of Manufacturing Processes, v 15, n 4, Oct 2013, Starting Page 659, Pages 7] The present study investigates the effect of tool shoulder profile on the mechanical and tribological properties of friction stir processed AZ31B magnesium alloy. The tool rotational speed and feed rate are the chosen process parameters. The experiments were conducted with 3 level 2 factors full factorial design. The recorded responses were tensile strength, wear losses and corrosion rate. The results were analyzed with the help microstructures of the processed samples. The study reveals that, for concave shoulder tool, the strain hardening effect was playing a major role in determining the properties of the processed materials and for the step shoulder tool, the grain size plays a major role in determining the properties of the processed materials. (15 refs, 12 figs, 4 tables) (AA)

109733 Evaluation of ionic fluids as lubricants in manufacturing
Libardi, A; Schmid, SR; Sen, M; Schneider, W [J of Manufacturing Processes, v 15, n 4, Oct 2013, Starting Page 414, Pages 5] This paper examines a number of ionic fluids, and determines their suitability as lubricants. This involves determining rheological properties, including viscosity and high-pressure viscosity, generally using a Barus law. In addition, their traction behavior is measured to evaluate their lubricating properties. Since metalworking fluids (and lubricants in general) are used in non-isothermal situations, the thermal conductivity of these fluids have also been measured. (14 refs, 8 figs, 1 table) (GM)

109734 Effect of fluid concentration in titanium machining with an atomization-based cutting fluid (ACF) spray system
Chandra Nath; Kapoor, Shiv G; Srivastava, Anil K; Iverson, Jon [J of Manufacturing Processes, v 15, n 4, Oct 2013, Starting Page 419, Pages 7] The aim of this work is to investigate the effect of metal-working fluid (MWF) concentration on the machining responses including tool life and wear, cutting force, friction coefficient, chip morphology, and surface roughness during the machining of titanium with the use of the ACF spray system. The test results demonstrate that the tool life first extends with the increase in MWF concentration and then drops with further increase. At low concentration (e.g., 5%), a lack of the lubrication effect causes to increase in a higher friction at the tool–chip interface resulting in severe chipping and tool nose/flank wear within a short machining time. On the other hand, at high concentration, the cooling effect is less. This increases cutting temperature and a faster thermal softening/chipping/notching of the tool material and higher friction at the tool–chip–workpiece interaction zones resulting in early tool failure. A good balance between the cooling and the lubrication effects seems to be found at the 10% MWF concentration as it offers the best machining performance. However, machining with flood coolant is observed to perform the best in the range of 5–7%. (20 refs, 7 figs, 3 tables) (AA)
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