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EDITORIAL

Editorial by V. K. Jain, I.I.T. Kanpur (India) for the special issue on "Micromanufacturing"

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Miniaturization of the devices and the products is taking place in every sphere of life starting from the kitchen household to the space technology because it saves material, electricity, space, labor, and money. The process of miniaturization is taking place at all scales of production and all sizes of products. This trend of miniaturization has led to a new paradigm in manufacturing named as "Micromanufacturing and Nanomanufacturing." This special issue (SI) deals mainly with micromanufacturing. This includes micromachining, microforming, microcasting, microwelding/microjoining, etc. These new areas need a lot more research inputs in terms of innovative new technologies for micromanufacturing. At present, a major part of the research work in this field, reported in the International Journals, is centered toward the scaling down of the macromanufacturing processes by playing around with the values of the process input parameters. To name some of these processes are micromilling, laser beam micromachining, electrochemical micromachining, laser beam-assisted microforming, and microcasting.

Analysis of most of these processes is based on the assumptions that whatever holds true in the case of meso- and macromanufacturing holds true in the case of micromanufacturing as well. However, this assumption does not seem to be very convincing. The analysis of micromanufacturing processes requires altogether a different kind of approach because in these processes, the material removal, deposition, or deformation is taking place at micro/nanolevel rather than meso/macrolevel. One new approach for microturning, micromilling, nanofinishing, etc. is the application of molecular dynamic simulation (MDS) which can give better results at micro/nanolevel than the theories developed for meso/macro level. The behavior and properties of the materials at micro/nanolevel material removal and material deposition are quite different from the one at macrolevel. Argument can be extended for thermal micromanufacturing processes, say, laser beam micromachining, electron beam micromachining, laser microwelding, laser-assisted microforming, etc. I believe that the time has come to develop not only new micromanufacturing technologies but also micromanufacturing science. It should help in better understanding of the processes so that the best possible can be extracted from the existing micromanufacturing processes. Multi-objective optimization of these processes would further enhance the process performance.

This special issue on "Micromanufacturing" has the papers (except last six papers) which have been expanded and re-reviewed, and which were presented in the 4th International and 25th All India Manufacturing Technology, Design and Research (AIMTDR) Conference held at Jadavpur University Kolkata during December 14–16, 2012. These papers were substantially expanded and re-reviewed as per the IJAMT policy. The papers of the SI can be grouped together in micromachining (traditional and advanced both), microdeposition, nanofinishing, microforming, and miscellaneous.

This special issue has two papers on the applications of laser beam. The first paper by Saha, Mukherjee, and Dhara of IIT Kharagpur reports the application of laser beam in microtexturing to modify the surface properties of titanium alloy (Ti6Al4V) by laser irradiation. By varying the process parameters, the surface topography of microgrooves was varied which affects surface wettability and the protein adsorption capability of the surface. The second paper by Kibria, Doloi, and Bhattacharyya of Jadavpur University (JU) reports the findings related to surface roughness obtained during laser microturning of aluminium oxide (Al_2O_3) at various laser defocusing conditions.

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Next, three papers belong to electrochemical and hybrid micromachining. The first paper of this class is authored by Manna and Kundal of PEC Chandigarh. It reports about the slicing of alumina ceramics using traveling wire electrochemical spark micromachining. Empirical model to evaluate material removal has been proposed. The next paper is by Bhattacharyya and Ghoshal of JU Kolkata. To improve the accuracy of the microchannel machined by electrochemical micromachining, the application of conical microtool has been proposed. The next paper is on generation of microgrooves authored by Rathod, Doloi, and Bhattacharyya of JU Kolkata. It presents parametric analysis of electrochemical micromachining (ECMM) process during production of microgrooves.

The next two papers are by Pandey, Rajput, and Jha of IIT Delhi and Muralidharan and Chelladurai of IITDM Jabalpur. These papers deal with microdeposition using electrochemical and electrodischarge processes, which are normally used for machining purposes. These papers deal with the fabrication of 3-D microparts and microfeatures using microdeposition. The eighth paper of this SI deals with numerical simulation of μ-EDM authored by Panda, Mathew, and Ramachandran of NIT Calicut and Somashekhar of DTE Bangalore. The specialty of the paper is that it considers the μ-EDM process having multi sparks at the same time rather than a single spark at a time which is assumed in most of the reported research work related to EDM theory. The ninth paper of this SI is on optimization of μ wire-EDM process authored by Kuriachen, Somshekhar, and Jose Mathew from NIT Calicut. The fuzzy logic and particle swarm optimization have been used to enhance the process performance. The tenth paper by Kumar details how to use EDM process for machining as well as finishing using nanopowder-mixed dielectric. The author is able to reduce the surface roughness *R*a value as low as 300 nm from the initial *R*a value of 1200 nm. The eleventh paper by Barman and Hanumaiah from CMERI Durgapur and Puri from NIT Durgapur reports the characterization of microfeatures using destructive testing method. The next paper is on quality of μ-holes produced using electric discharge micromachining (EDMM) by Dave, Mathai, Raval, and Desai (SVNIT Surat). They used tungsten electrode of 300 μm, and the experiments were designed using Taguchi technique. The following paper is also experimental in nature and it gives details about the characterization of μ-holes drilled using electric discharge microdrilling operation in a thin plate. This paper is authored by Mondol, Azad, and Puri. They have developed empirical models for MRR, TWR, overcut, and taper. They have also reported multiple response (or objective) optimization. The last paper in this class is again on EDMM of titanium alloy. This paper is authored by Pradhan, Tewary from SMIT, and Bhattacharyya from JU Kolkata. They have presented parametric analysis of the EDMM process, and the accuracy claimed by the authors is of the order of 100 nm.

The next two papers are on nanofinishing using grinding and MR polishing process. Paper # 15 of this SI is on "Microgrinding characteristic of polycrystalline diamond (PCD) tool" by Ramesh from the Univ. of Cape Town. To overcome the difficulties faced during grinding of PCD, a micro-/nanogrinding technology is used with a controlled amount of grinding force. It has resulted into surface finish of the order of 50 to 110 nm. The following paper in this class is by Das (IIT Guwahati), Jain, and Ghoshdastidar (IIT Kanpur) on "A 2-D CFD simulation of MR polishing (MRP) medium in magnetic field assisted finishing process using electromagnet." The beauty of the paper is 2-D computational fluid dynamic simulation of MR polishing medium.

Only one paper (#17) is available by Sondur (Univ. of Florida), Pawar (IITB), Salunke (Cummins, Pune), Salunke (IIM B'lore), and Patil (COE, Pune) which deals with microforming, and it is entitled as "A model for deformation in high energy rate microforming process." The highest error in this prediction is claimed to be around 30 %.

Paper # 18, 19, and 20 deal with micromilling. Paper # 18 reports the findings about the "Tool deflection model for micromilling process" authored by Rodriguez and Labarga from the Univ. of Leon. This paper accounts for the tool deflection phenomenon for a reliable prediction of the cutting forces in micromilling. The predictions are claimed to help in the design of adaptive control for a CNC milling m/c for the prevention of tool failure. The next paper is on the "Analysis of tool deflection in micromilling of graphite electrodes" by Mijuskovic, Kragnik, and Kopac. In this paper, tool deflection is analyzed assuming the tool as a four-section cantilever beam, and then the effects of cutting parameters on the deflection are evaluated experimentally. The developed models' results are compared with the experimental results. The last paper in this class is on "Evaluation of the machine tool motion accuracy using a CNC machining center in micromilling process" by Ciurana, Vazquez (from the Univ. of Girona) and Rodriguez (from Technologic de Monterry). It is found that due to the inertia of the m/t, acceleration and deceleration affect the accuracy and quality of microparts.

The last but one paper of this SI is on "Dynamic design methodology of high-speed microspindles for micro/mesoscale machine tools" by Zhang (Harbin Institute of Tech.) and Ehmann (Northwest Univ., USA). A new dynamic design methodology has been proposed for controlling run-out of high-speed microspindles in micro/mesoscale machine tool. The last paper of this special issue is on "Fabrication of 3-D random microlens array composite optical film with self assembly" by Hsu and Chen (National Kaoshing Univ. Taiwan, ROC). The PET optical film is used in the green energy lighting testing of commercial bicycle LED light. The results show the increased lighting angle and light uniformly making it similar to traditional tungsten light.

I am thankful to ex editor-in-chief, the late Prof. B.J. Davis, and current editor-in-chief, Prof. Andrew Yeh-Ching Nee of IJAMT who kindly agreed to bring out this special issue on "Micromanufacturing" from the expanded and re-reviewed papers presented in the AIMTDR conference held at JU Kolkata and some papers independently submitted to the Journal, by global researchers. I am also thankful to the organizers of the conference who shouldered this responsibility of special issue on me. I highly appreciate the efforts made by the authors in improving their papers presented in the conference, and the referees for thorough evaluation of these papers by providing useful and critical comments to improve the quality of the papers. Last but not least, I would like to put on record the help and cooperation extended by Esplana, Sean, Springer International Journal of Advanced Manufacturing Technology, Editorial Office, Dennis E. Villahermosa and Doyle, Anthony, Springer Journals.

-V. K. Jain