March 28, 2008
Abrasive Users News Fax © 2008 Vol. 12 No 5

Precision Manufacturing

By David Dornfeld and Dae-Eun Lee
Published by Springer
ISBN 978-0-387-32467-8

Available from News Fax for $129 plus s&h

BOOK NOTES

If you accept the famous graphic of Taniguchi that shows ever shrinking component size and ever increasing machining accuracy, then Precision Manufacturing will be a good indicator of the future of machining. This book, which focuses on economical machining of mass quantities of precision components, details advanced technologies that have been driven by the semiconductor and electronics industries. The processes include many abrasive methods with the most attention to lapping, polishing and free abrasive machining. Following are comments derived from the book contents. For details see the AES website: ww.abrasiveengineering.com

___The future of precision machining will require much greater attention to measurement technologies and metrology: How you measure will be as important as what you measure. Essential is an awareness of the limits of measurement and definitions of accuracy, repeatability, and resolution. In chapters on measurement Dornfeld shows the importance of statistics in limiting such terms. Precision part makers will be schooled in advanced metrology.

___In the world of ultra-precise measurements, control of errors is critical. The focus will shift from errors on the workpiece to errors generated by machine components and their movements. Since most of the energy applied in a machine tool is eventually converted into heat, the temperature of the environment and tools must be controlled to prevent thermal changes. Vibrations from every source must be minimized, because the dynamic movement could exceed extremely small tolerance limits. To handle the cumulative effects of the many sources of errors, an error budget must be setup and managed.

___In the future, sensors will play a bigger role in machines for both monitoring and controlling processes. Machinists have always made judgments based upon sounds, but new sensors with extend their reach considerably. A review of the many sensors available in this evolving technology shows a current emphasis upon acoustical emission sensors measuring everything from grinding wheel wear to work-wheel gaps. Developments of intelligent sensors and the integration or “fusion” of multiple sensors are among the latest innovations. Intelligent sensors applied to TCM (tool control monitoring) will make process decisions based upon interpretation of data from multiple sources.

___In the future, integration of machining requirements in early stages of component design will be necessary to reduce costs. While higher tolerances generally mean higher costs, early consideration of needs for machining could actually reduce costs. The benefits of such planning are illustrated by a discussion of burrs and edge finishing reflecting work at the University of California at Berkeley. Software and modeling will be essential tools for planning.

___Microfabrication will become more prevalent. Microfabrication, a generalized term for processes such as CMP applied to semiconductors and other microelectronics, is a unique process compared with scaled down versions of conventional grinding and machining processes. In a simple form, microfabrication is the replications of millions of parallel, two-dimensional structures. The potentials for microfabrication can be seen in the many applications with Micro-Electro-Mechanical-Systems (MEMS), which integrates mechanicals, sensors, actuators and electronics into a single device. Lists on the website for the Berkeley Sensor and Actuator Center demonstrate the range of possibilities for smart products using MEMS technology.

__Precision manufacturing will include the field of nanotechnology, the next logical step in degrees of precision. Although current technology makes it possible to fabricate simple components from hollow carbon tubes the field is mostly unexplored. But organizations worldwide are gearing up to study the many facets of this complex subject. Scaled down versions of MEMS applications hold great promise for nanotechnology and the vastly different properties of materials reduced to the nanometer scale suggests many new uses.

___The advances in precision machining will enable the manufacture of more meso-scaled devices, units that are larger than MEMS but smaller that today’s conventional components. Such products as micro milling cutters, mold dies or pressure sensors could be manufactured by more conventional means using smaller tools. With small chip loads and low cutting forces, high speed and rapid acceleration/deceleration will contribute significantly to quality and the ease of making such parts.

144 Moore Road, Butler, PA 16001 --abrasive@abrasivesmall.com phone 724-282-6210 fax 724-234-2376

http://www.springer.com/978-0-387-32467-8

Precision Manufacturing
Dornfeld, D.; Helu, M.M.
2008, XX, 775 p., Hardcover
ISBN: 978-0-387-32467-8