Center for Precision Metrology (CPM)

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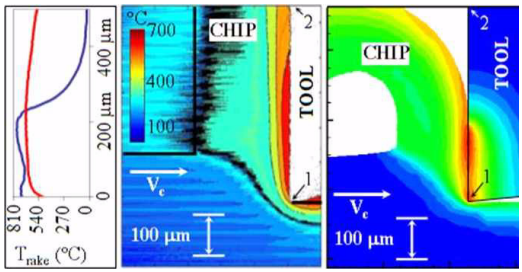
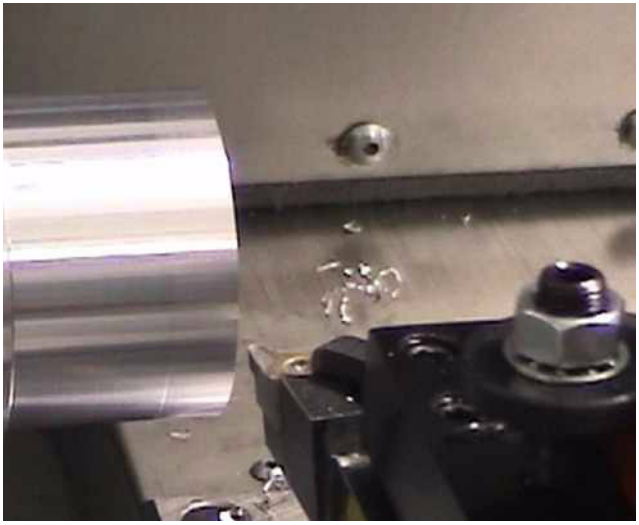
Center website: http://www.cpm.uncc.edu/

Thermal Microscopy of High Speed Machining



In an effort to move to science-based production simulation, the temperature profiles at the cutting interface between in machining have been measured and parameters extracted for use in models. The data obtained were used in three-dimensional finite-element models to estimate tool wear. The data generated by this work is extremely useful in tool design, developing a fundamental knowledge base for the design of new high-speed machining processes and development and the development and validation of models for machining processes.
For more information contact Angela Davies, 704.687.8135, adavies@uncc.edu at the University of North Carolina at Charlotte.

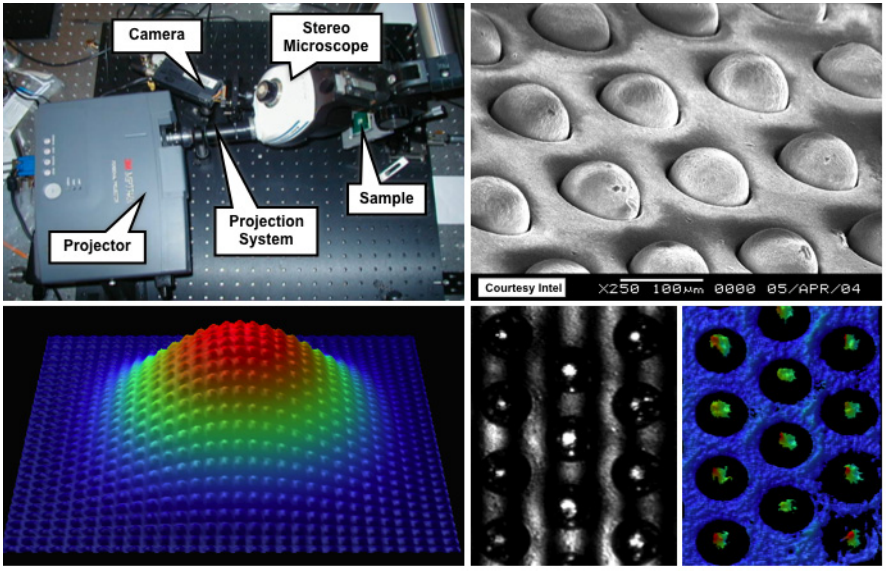
Chip Breaking



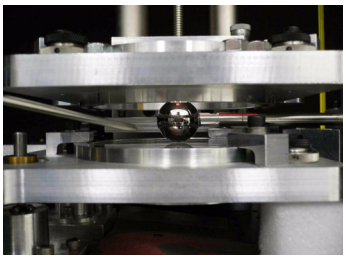
Special materials requiring machining operations with no physical operator interaction often form springy chips which interfere with the process and may force expensive parts to be scrapped late in the manufacturing cycle. By choosing non-traditional tool paths that are now possible with computer-controlled machines, small chips can be reliably produced enabling operation without human monitoring or intervention.
For more information contact Scott Smith, 704.687.8350, kssmith@uncc.edu.

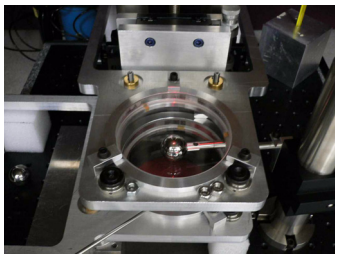
CPM Moiré Fringe Metrology

Researchers at the Center for Precision Metrology have developed a system that uses structured white light to make dimensional measurements on any surface that can be sufficiently illuminated. As a metrology technique for measuring first level interconnect features in the semi-conductor packaging industry this method has proven to be about twenty five times faster than the historic white light interferometry technique. This new method has allowed the semi-conductor industry to maintain quality control of the first level interconnect as customer requirements continue to demand higher bump densities. Extensions to this technology have shown it to be versatile enough to make macro level form measurements as well as roughness. Current substrate metrology capabilities may be extended to support additional features of interest such as substrate shape and/or solder resist roughness. The easy availability of this type of data may allow for improved substrate manufacturing and improved yield during assembly. For more information, contact Angela Davies, 704.687.8135, adavies@email.uncc.edu or Faramarz Farahi, 704.687.8136, ffarahi@uncc.edu, both at the University of North Carolina at Charlotte.



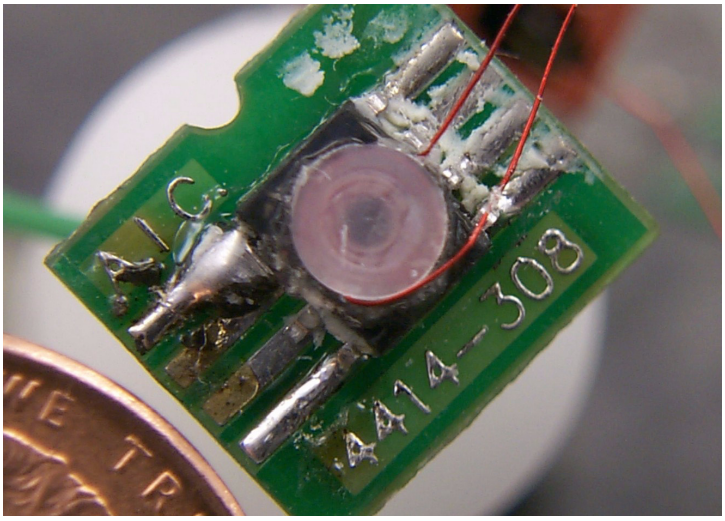
International Dimensional Assessment with Nanometer Scale Agreement





With the realization of global economics and nanometer-scale toleranced manufacturing for meso-scale part dimensions, it is necessary to expand, compare, and confirm techniques for the realization of low uncertainty measurement. Measurement capability for the diameter measurement of nominal 25.4 mm spheres was developed with international round-robin agreement with less than one part in a million (the order of nanometers) with the US and German National Laboratories, the National Institute of Standards and Technology and the Physikalisch-Technische Bundesanstalt. For more information, contact Robert Hocken, 704.687.8496, hocken@uncc.edu.

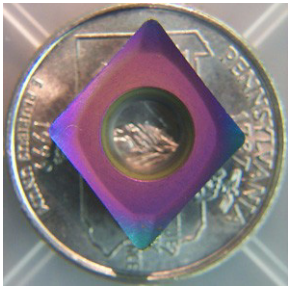
Giant Magneto-Resistive Eddy Current Sensor



These miniature sensors utilize the Giant Magneto-Resistive (GMR) property that has been demonstrated in some materials. The GMR property is present when an external magnetic field significantly alters the resistance of a conductor. The device produces a magnetic field and then measures it using a GMR device. When the sensor is scanned near a material, the structure of that material influences the magnetic field. If there is the presence of a micro-crack (surface or subsurface) in the nearby material, eddy currents are generated which are clearly discernible to the sensor. By enabling the detection of subsurface cracks, catastrophic failure of materials can be predicted which was hitherto impossible. The device has applications in aerospace where cracks near bolted joints are a problem and also in railroad rail systems where defective tracks can be replaced before there is a problem. The project resulted in U.S. Patent 6,504,363 and was the lead technol-

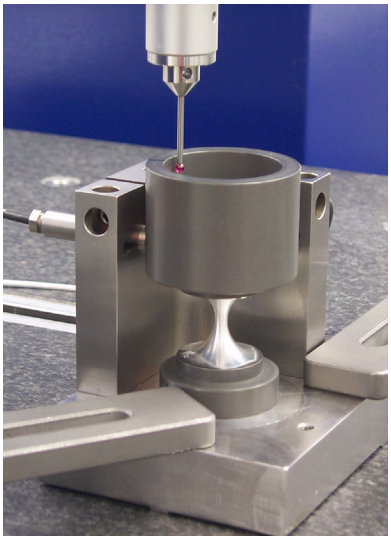
ogy for a spin-off company. For more information, contact Robert Hocken, 704.687.8496, hocken@uncc.edu.

Diamond Thin Films



The development of techniques for depositing thin diamond films on surfaces was advanced for the purpose of producing wear-resistant machine tooling. Diamond has two very useful properties. It is extremely hard and it is an excellent thermal conductor. Results of diamond research conducted at the Center for Precision Metrology (CPM) has yielded coating tools that have greater wear resistance and better removal of heat from tool/workpiece interfaces. The latter may increase the material removal rate for materials such as titanium which have traditionally been machined at very slow rates in order to prevent flash combustion and material softening due to near melting temperatures. Additionally, less coolant may be required resulting in a more environmentally friendly processes. The processing techniques have provided the basis for the development of technologies for a pending patent. A company is refining the techniques studied and is producing nanocrystalline diamond coatings with characteristics that offer increased durability, transparency, and protective characteristics with possibilities for anti-icing and abrasion protection for aircraft surfaces. The company is also looking at uses for artificial joints. For more information, contact Robert Hocken, 704.687.8496, hocken@uncc.edu.

Standards for Tight-Tolerance Manufacturing Machines



Researchers at the Center for Precision Metrology (CPM) had several projects directed toward developing performance evaluation standards for coordinate measuring machines (CMMs). These are machines critical for verification of tight-toleranced manufacturing in the U.S. Along with the development of the standards. A device for performance evaluation of these machines was patented (U.S. 6,434,845) and licensed to a major U.S. supplier of metrology equipment. The device is capable of measuring probing forces, which may be sufficient to damage a component that is to be measured. Additionally, it is capable of assessing the ability of CMM's to scan parts for reverse engineering purposes.
For more information, contact Robert Hocken, 704.687.8496, hocken@uncc.edu.