MECHANICAL MICRO MACHINING - PRODUCTION AND RESEARCH FACILITY (MMM - P&R)

To connect industry with academic world for collaboration with faculty and students,
To provide solutions and technology transfer to support manufacturing industries

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Overview

The Mechanical Micro Machining - Production and Research Facility is located at the Indian Institute of Technology Madras in the Manufacturing Engineering Section of Department of Mechanical Engineering.

Background

The facility was established in 2008 with major funding of Rs. 353.35 lakhs from the Department of Science and Technology (DST) and additional funding of Rs. 60 lakhs from IIT Madras. Certain other facilities developed indigenously are also housed in the same building.

Purpose

- To develop knowledge driven manufacturing and create high value products, materials, methods and processes.
- To work with innovative companies of all sizes from a wide range of sectors, including aerospace, automotive, medical devices, consumer products and power engineering.
- To respond with resources and match industrial needs and time scales.

Organization

The facility draws upon expertise from academic faculty and interdisciplinary collaborative research and development group. Wide range of state of the art high technology equipment and laboratories ably supported by specialist technicians provides a unique opportunity to carry out activities from concept generation and simulation to industrial applications.

Facility:

The mechanical micro machining production and research facilities are located in the air conditioned metrology laboratory. The laboratory includes KERN 5-axis Ultra precision CNC micro machining centre (DST) and high precision 3-axis miniaturized machine tool (ARDB) to support the production activities. The laboratory also supports various kinds of measurement work with the help of KISTLER cutting force measurement system, VEECO contact surface profile measuring system and non contact (optical) surface profile measuring system. A nano-finishing setup for mangetorheological abrasive honing is an added facility.

MECHANICAL MICRO-MACHINING FACILITIES

Kern EVO

SALIENT FEATURES

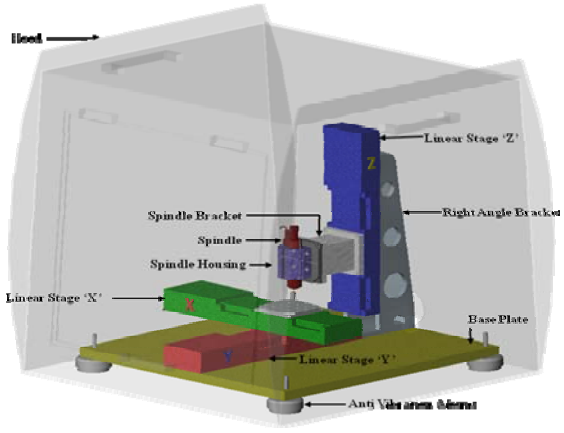
Polymer concrete machine frame
Automatic workpiece changing system: 24 Pos.
Automatic tool changer (ATC): 32 positions
Laser measuring system: Tool measurement
Touch probe system: Workpiece measurement
Macro-video microscope: Viewing operation
Optical microscope: 30X
Lubrication: Oil mist / Flood

TRAVERSE & PRECISION

X= 300 mm, Y=280 mm, Z = 250 mm
Resolution: 0.1 µm
Positioning scatter: PS ±0.5 µm
Positioning tolerance: P ±1.0 µm
Precision on the workpiece (3-axis): 2.0 µm

OPERATIONS

Drilling: 0.04 mm onwards; Tapping: 0.4 mm onwards; End-milling: 0.1 mm onwards; Five axes simultaneous control; spindle rpm upto 160,000.



Miniature Machine Tool (MMT)

SALIENT FEATURES

Anti-vibration table mounting
Cooling: Air
Spindle run out: < 1 µm

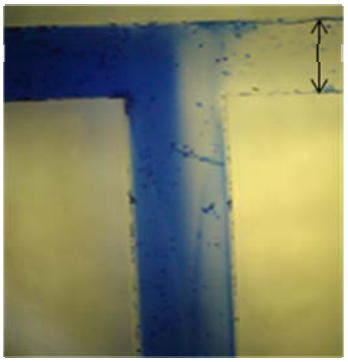
TRAVERSE & RESOLUTION

X= 150 mm, Y=150 mm, Z = 150 mm
Resolution: 0.1 µm

OPERATIONS

Drilling: 0.1 mm onwards; End-milling: 0.2 mm onwards; Three axes control; spindle rpm upto 100,000.

TYPICAL PRODUCTS



Micro channel for micro-reactor study

Impeller

DYNAMOMETER FOR MEASUREMENT OF FORCES WITH mN RESOLUTION

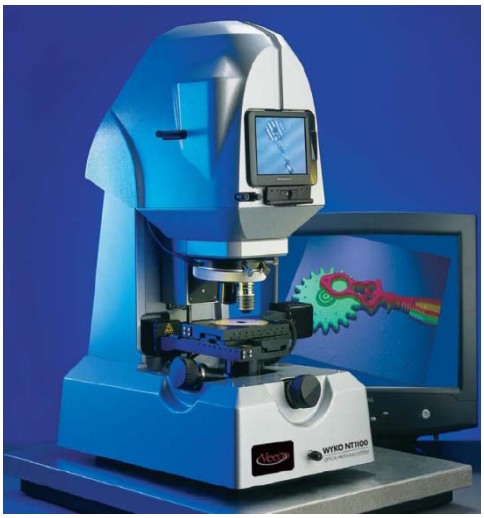
Mini dyne 9256 C2

Measuring range	Fx, Fy, Fz	N	–250 to 250
	Mx, My	Nm	-11 to11
Overload	Fx, Fy, Fz	N	–300/300
Threshold		N	<0.002
Sensitivity	Fx, Fz Fy	pC/N	≈–26 ≈–13

NANO-MEASUREMENT FACILITIES

Dektak 150

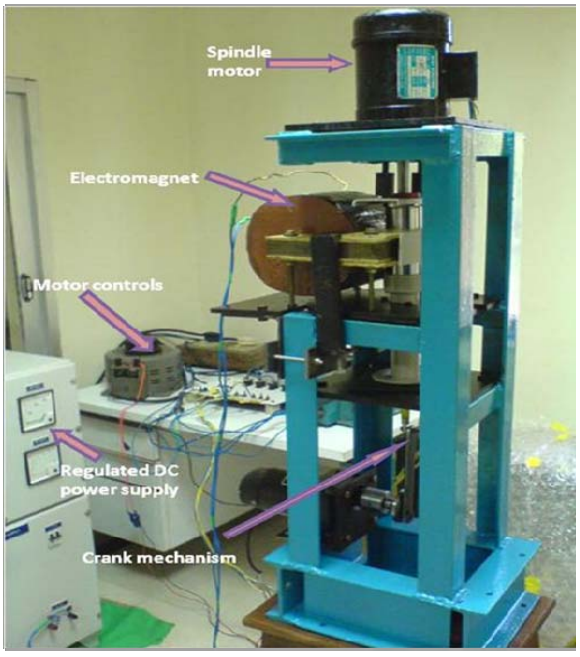
SALIENT FEATURES
Measurement technique: Stylus profilometry
Measurement capability: 2d & 3d
Sample viewing: 640 x 480 pixel camera
Stylus radius: 2.5 & 12.5 µm and high aspect ratio tip (200 µm x 20 µm)
Scan length range: 55 mm
Data points per scan: 60,000 max.
Max. sample thickness: 100 mm
Max. wafer size: Φ150 mm
Step height repeatability: 6 Å
Vertical range: 1000 µm
Vertical resolution: 1 Å max.



Wyco NT1100

SALIENT FEATURES
Measurement technique: optical phase-shifting and white light vertical scanning interferometry
Measurement capability: 3D, non contact
Objectives: 20x, 50x, manual turret
Measurement array: max. 736 x 480
Light source: tungsten halogen lamp
Vertical measurement range: 0.1 nm to 1 mm
Vertical resolution: < 1 Å Ra
Scan speed: up to 7.2 µm/s
Lateral spatial sampling: 0.08 to 13.1 µm
Maximum slope: 25° to 1.8°

INDIGENOUS DEVELOPMENT OF MAGNETORHEOLOGICAL ABRASIVE HONING FOR NANO-FINISHING



Description: Magneto Rheological Abrasive Honing uses a smart fluid which stiffens on application of magnetic field. The ferromagnetic particles in the fluid get dipole moment and thus aggregate to form a chain of dipoles in the direction of the applied magnetic field. The MR fluid used is natural castor oil mixed with carbonyl iron particles, 15 µm abrasive SiC particles (25% by volume) and and suitable surfactant. This abrasive mixed MR fluid acts like a flexible abrasive brush and its finishing force can be controlled conveniently by adjusting the magnetic field. Finishing of external curved surfaces is done by imparting rotation while the abrasive-mixed MR fluid is pushed up and down.
Highlights of the work: This is an interdisciplinary research work involving fluid mechanics, rheology, mechanical engineering and magnetism. MRAH can be a break-through technology and can replace many of the existing non-traditional abrasive assisted finishing processes. It is more controllable and faster. This technology which is capable of finishing complex biomedical implant surfaces, has potential for licensing.
Awards Received: Suryanarain Rau Memorial Senior Student Award – 2009 (ISAMPE) & Best Thesis Award - 2010 (INAE).

Contact Prof.M.S. Shunmugam to know more….