MICROMACHINING RESEARCH CENTRE

There has been a rapid growth in the development of harder and difficult-to-machine metals, composites and alloys during the last two decades. Conventional edged tool machining to micro level is uneconomical for such materials and degree of accuracy, surface finish attainable is poor. The micro scale manufacturing possesses unique challenges with respect to machine tool design, development and the process dynamics. Micro systems find wide applications in bio-medical electronics, optics, micro-mechanics, micro fluidics, dies, moulds etc. Component parts used in these systems have feature dimensions in micrometers and part volumes less than $1mm^3$. Manufacture of these miniature components with high accuracy is a challenge. Further, Micromachining is defined as:

- Material removal at Micro/Nano level with no constraint on the size of the component being machined.
- Creating micro features or surface characteristics (especially surface finish) in the Micro/Nano level.
- Removal of material in the form of chips or debris having the size in the range of microns.

VISION

- To foster new knowledge and achieve leadership in Micromachining research and cater the ever-expanding academic and research needs.

MISSION

- To develop knowledge driven micromachining and create high value products, materials, methods and processes.
- To identify the gap and perform a feasibility study of modeling and simulation of micro-machining for various applications.
- To develop and design special attachments to existing conventional machines to achieve surface finish at Micro/Meso levels.
- To connect industry with academic world for collaboration with faculty, students and industry.
- To apply critical thinking skills and knowledge of engineering and technology to identify, analyze, and solve problems during the design, development, implementation and improvement phases of research projects.

OBJECTIVES

- To perform feasibility study of modeling material removal processes (machining) at the micro level and to explore diverse areas of micro technology with the aim of identifying potential applications of interest.
- To machine alloys, composites at micron level surface finish on Wire Cut EDM.
- To provide solutions and technology transfer to support manufacturing industries.
- To design and implement a complete solution for an inline topography measurement and analysis for monitoring before, during and after the micro machining.

DESCRIPTION OF THE CENTRE

The Micromachining research centre in the Department of Mechanical Engineering at Sree Vidyanikethan Engineering College, Tirupati draws upon expertise from academic faculty and interdisciplinary collaborative research and development group. Wide range of state-of-art high technology equipment and support by specialist technicians/faculty of the department provide a unique opportunity to carry out activities from concept generation, simulation, micromachining extended to industrial applications and students/faculty research. The micromachining research centre-oratory facilities are continuously being enhanced to cater the ever expanding academic and research needs.

OUTCOMES

1. Researcher will be able to develop knowledge driven micromachining and create high value products, materials, methods and processes.
2. Researcher will be able to machine to a micron level in developing MEMS and Non-MEMS devices.
3. Researchers will be able to develop and design special attachments to existing conventional machines to achieve surface finish at Micro/Meso levels.
4. Researchers will be able to apply their critical thinking skills and knowledge of engineering and technology to identify, analyze, and solve problems during the design, development, implementation and improvement phases of research projects.

THRUST RESEARCH AREAS OF THE CENTRE

The Micromachining research centre builds research on the following two indigenous micro machines to design solutions to modern engineering challenges in MEMS and Non-MEMS and applies the Mechanical Engineering core strengths to key thrust areas of great current and future need.

1. Micro-Wirecut Electro Discharge Machining

Wire cut EDM machining is mainly used to process various punch tie, plastic mold, Powder metallurgy mold and etc, which have 2D and 3D faces combined, or components. It can also cut various sample plate, magnetic steel, Silicon Steel Sheet, semi-conductive material or precious metal. Furthermore, it is able to do tiny machining, abnormal shape groove or machining of standard defect of sample parts, widely used in electrics, precious machine tools, light industry, army industry and so on. The Wirecut Electric Discharge Machining (WEDM) is a variation of EDM and is commonly known as wire-cut EDM or wire cutting. In this process, a thin metallic wire is fed on-to the work piece, which is submerged in a tank of dielectric fluid such as deionized water. This process can also cut plates as thick as 300mm and is used for making punches, tools and dies from hard metals that are difficult to machine with other methods**.**

2. Tool based Mechanical Micromachining

The micro-products and micro-components are used in many industries especially related with micro-electromechanical, aerospace, medical, environment, biomedical and biochemical industries etc. Tool based mechanical micromachining technology is gaining importance in Micro-Electro Mechanical System device fabrication because of its ability to machine 3D micro features on different engineering materials. Micromachining with mechanical cutting tools is capable of producing high profile accuracy, surface finish quality, and sub-surface integrity at a reasonable cost. It is the primary choice amongst various manufacturing processes in fabricating micro components. Micro cutting and micro grinding are two typical micro mechanical machining processes that employ a defined cutting edge and an undefined cutting edge respectively. Many manufacturing methods have been developed to produce these micro-sized products, namely micro electro mechanical system (MEMS) based processes such as dry etching, lithography, electroplating, ultraviolet - Lithography Galvanoformung Abformung (UV-LiGA), non-conventional based micro-machining such as micro- electron discharge machining (EDM), and mechanical micro-machining Mechanical Micro-machining

AVAILABLE FACILITIES

The mechanical micromachining research centre at Sree Vidyanikethan is established in an air-conditioned environment within an area of 900 sq ft. with machining, computing, characterization and data acquisition facilities. The research centre is equipped with the latest technology incorporated micro machines, attachments and accessories to support production activities. The major equipment includes:

1. Micro wire EDM, Make: CONCORD
2. FLEX TURN: Micro turning machining, Make: MTAB
3. JV55: Vertical machining centre, Make: Lakshmi Machine Works Limited
4. SMART TURN: CNC Lathe, Make: Lakshmi Machine Works Limited
5. RS400: Manual metal arc welding, Make: ESAB
6. TRANSWELD 400: Manual metal arc welding, Make: ESAB
7. EASY WELD SSR 400T: Manual metal arc welding, Make: ESAB
8. EASY WELD SSR 400T: TIG welding, Make: ESAB
9. AUTO K400: MIG/MAG welding, Make: ESAB
10. MACK 250: MIG/MAG welding, Make: ESAB
11. Gas cutting and welding equipment
12. High end metallurgical microscopes(50x - 1000x)
13. Material Plus software
14. Surface roughness tester, Make: MITUTOYO
15. Profile projector, Make: MEERA METZER
16. Inverted metallurgical microscope, Make: MEIJI
17. Progres Gryphay subra: Imaging system, Make: JENOPTIK
18. D-271: Autocollimating alignment telescope, Make: DAVIDSON OPTRONICS

1.Micro wire EDM, Make: CONCORD

Specification of the Machine

- Table Travel X,Y Axis (mm) : 250 x 320
- Work Table Size L x W (mm) : 380 x 525
- Maximum Work Piece Thickness : 300 (mm)
- Maximum Taper / 100 mm Thickness : ±3° (Standard)/ ±30° (Optional)
- Maximum Work Piece Weight (kgs) : 300
- Machine Weight (kgs) : 1600

Standard Features

- Maximum Speed : 80mm2/Min.*
- Machining accuracy : 0.01mm *
- Best Surface Finish : Ra 1.25 to 1.75 *
- A.C. - Not Required up to 40° C
- BMXP pm-k system software controller works on Windows 7 operating platform
- Inbuilt database for cutting different materials.
- Coolant filtering system - Fine stainless steel wire mesh for coolant filter
- No need to change wire guide for different diameters
- Two axis DRO (Std.)
- 4-Axes synthesizer to cut different profiles at top and bottom
- Auto centre and auto stop at the end of the job

2. FLEXTURN: Micro turning machine

Specification of the Machine

- Make: MTAB

Capacity

- Chuck size : 100 mm
- Maximum Turning Diameter : 80 mm
- Maximum Turning Length : 195 mm
- No of Axes : 2

Accuracy

- Positioning : 0.010 mm
- Repeatability : ±0.005 mm

Spindle

- Spindle speed range : 150-4000rpm
- Spindle motor : AC Servo
- Spindle motor capacity : 3.7 Kw 5 HP

CNC Details

- Control : Siemens

Turret & Tooling

- Number of stations : 8

Axes

- X-Axis travel : 95 mm
- Z-Axis travel : 210 mm
- Rapid feed rate : X & Z 5 m/min
- Feed rate : 0-5000 mm/min

Tail stock

- Tail stock base stroke : 170 mm
- Tail stock quill stroke : 30 mm
- Quill diameter : 35 mm

Machine dimensions

- L x W x H (Approx.) : 1700 mm x 1100 mm x 1650 mm

Power source

- Input main supply : 415 V, ±2% 50 Cycles
- Transformer for drives : 3 Phase 10KVA 3 Phase

3. OTHER AVAILABLE FACILITIES

Vertical machining centre

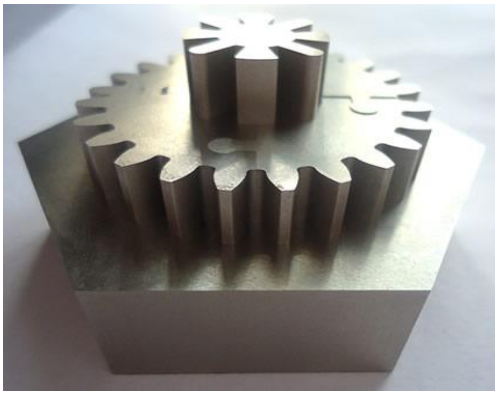
CNC Lathe machine

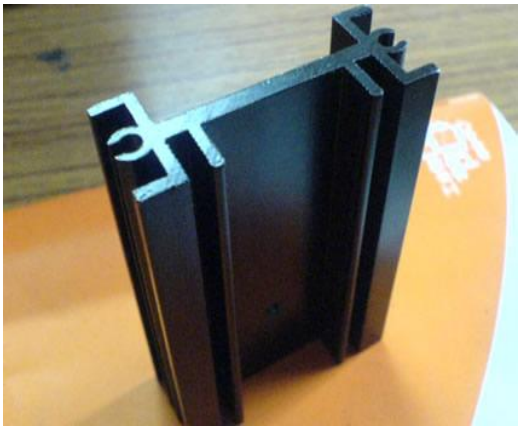
Metallurgical microscope

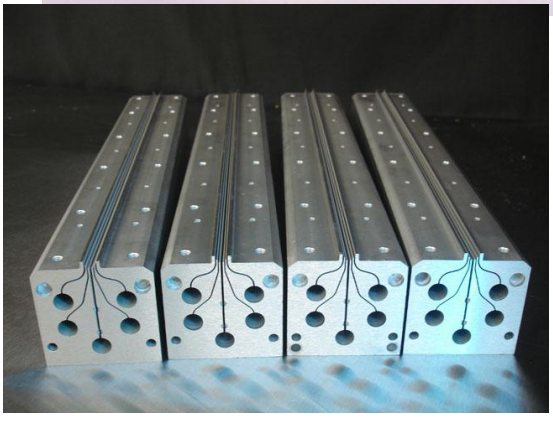
Surface roughness tester

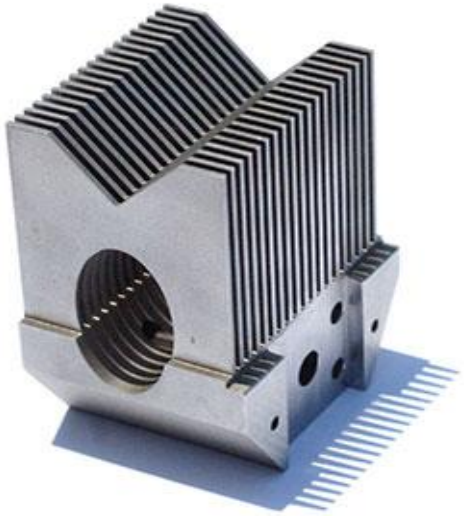
Profile projector

Types of profiles machined on Wirecut EDM









RESEARCH GROUP

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