

# **Introduction and Applications of Micromachining**

# Introduction

- ❖ **Emerging miniaturization technologies have been perceived by many as potential key technologies of the future**
- ❖ **Nowadays, miniaturization techniques have become a trend in product design and manufacturing**
- ❖ **By miniaturization, efforts are made to increase the utilization of equipment and systems to produce micro-scale components and products**
- ❖ **Miniature components are increasingly needed for a wide range of application in the various fields such as biotechnology, aerospace, semi-conductor industry, electronics, medical robotics, optics and consumer products**

# Significance of Micro Manufacturing

- **Efficient utilization of space:** More machinery can fit in less space, with stacking or three dimensional alignment
- **Saving energy and material resources**
- Reduced vibration and noise for workers
- **Easier control** of waste and pollution
- **Reduced need for capital investment** in the machinery itself and facilities such as land space, buildings, power sources, environmental conditioning, etc.
- **Improved portability** and agile re-configurability
- **Higher Speed:** A high acceleration is easy to achieve because of reduced inertial.

❖ **The micro mechanical manufacturing systems have the following advantages**

- **increased productivity**
- **high efficiency in utilization of resources**
- **low power consumption**
- **flexibility**
- **low cost**
- **can use various materials including steel and its alloys, ceramics, polymers..**

# Micromachining

- Micromachining is the techniques used to produce the 3D structures, devices and moving parts with dimensions/features in the order of micrometers

# Micro gears

- The micro gear as used in a Micro Drives
- The micro gears have been successfully implemented in a wide variety of miniaturized servo actuators.
- They have advantage of zero backlash
- The use of the micro gears along with the provision of zero backlash also offers excellent repeatability and a long operating life.



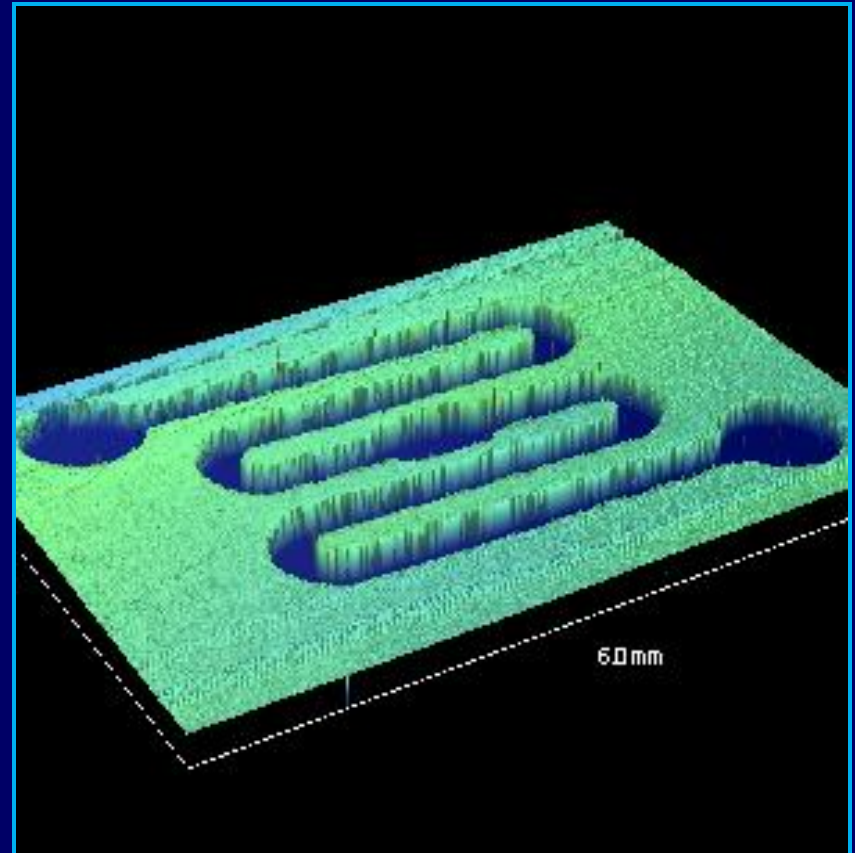
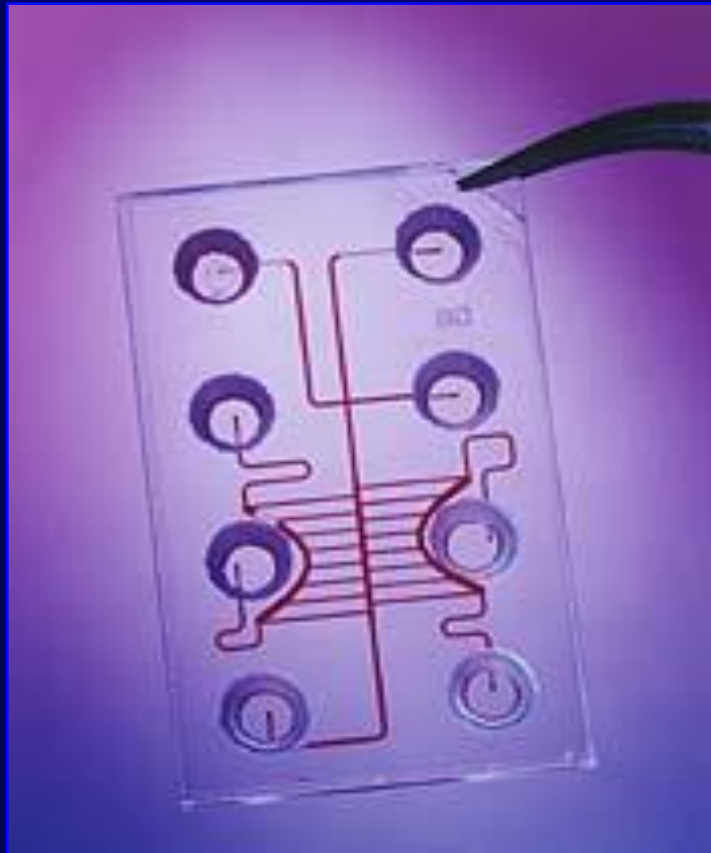
# Bio Medical Applications

- Painless injection/micro needles
- Laparoscopy
- Pin hole surgery



Flexible video endoscope

# Lab on a Chip





# Mechanical Micro machining

To lay her eggs, the female parasitic fig wasp has to pierce the tough skin of unripe figs. Luckily, she has a built-in power tool: A drill-bit-like appendage that's thinner than a human hair and tipped with zinc, a new study reveals.

"If you look at this structure, it's so beautiful in the sense that it's hard but maneuverable, which is a tough challenge" for a drilling tool, said study leader Namrata Gundiah, a mechanical engineer at the Indian Institute of Science in Bangalore, India. ([Watch a video of a parasitic wasp at work](#) )



## Natural Inspiration

Even with a zinc-hardened tip, the long ovipositor is so slender that the researchers wondered how it could bore into figs several times in the wasp's life without breaking.

When Gundiah and Kundanati filmed the wasps boring into figs, they observed the ovipositor bend and flex but not break. By calculating the buckling pressure on the structure, Gundiah learned that “it can't fracture when it buckles, so it's a very cleverly made design.”