

Departimento Interateneo Di Fisica "M. Merlin"

**FEMTOSECOND LASER MICROFABRICATION
TECHNOLOGY FOR THE DEVELOPMENT OF
DISPOSABLE POLYMERIC LAB-ON-A-CHIPS**

Industrial PhD with ST Microelectronics Lecce
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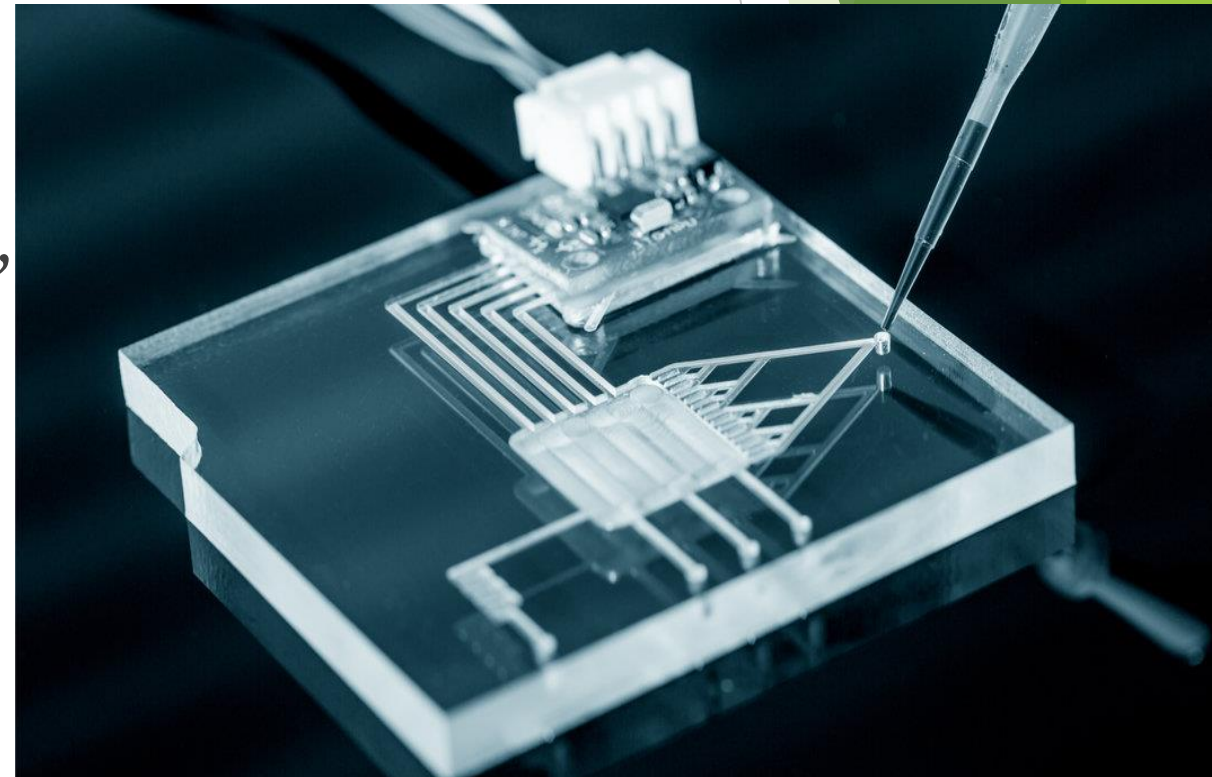
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- ▶ FEMTOSECOND LASER TECHNOLOGY FOR LAB ON A CHIP
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INTRODUCTION

- ▶ Growing interest in the development of microfluidic devices
- ▶ Device requirements :
Integration, automation, miniaturization, sample processing
- ▶ Advantages: low contamination, low cost, fast diagnostics, etc

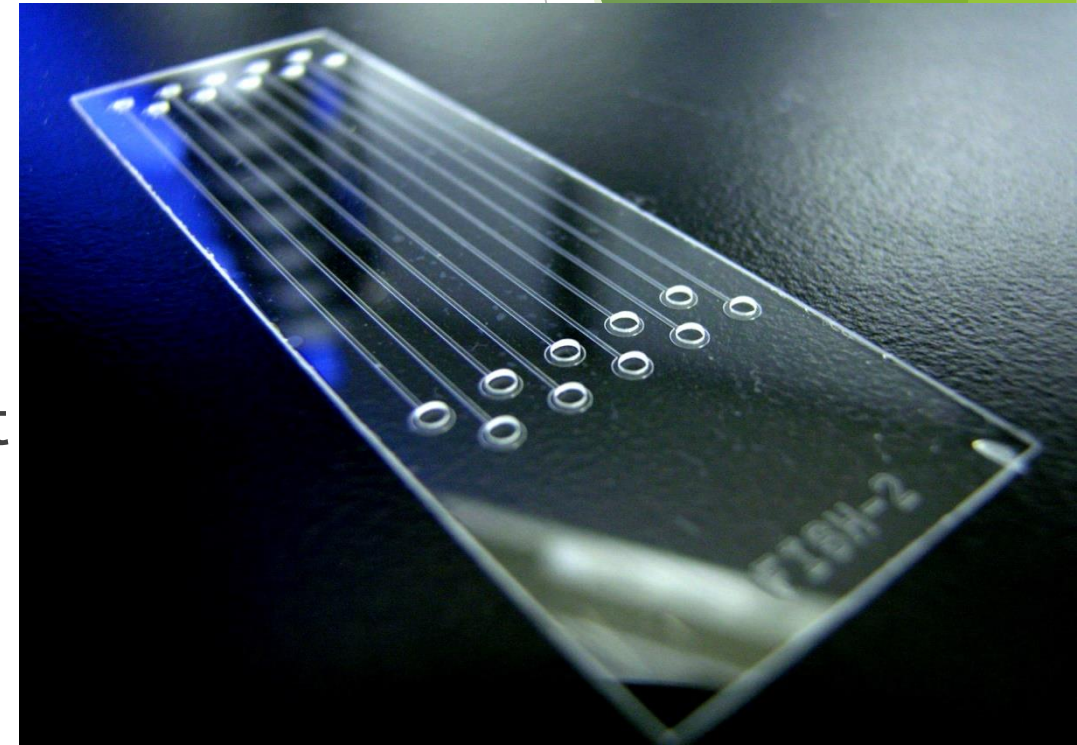
WHAT IS LAB ON A CHIP

- ▶ Device integrated in a chip
- ▶ Application in various fields of life sciences and chemistry
- ▶ Point-Of-Care Test (POCT)
- ▶ Advantages : tests directly at the patient's site, result in a few minutes, small amount of biological samples



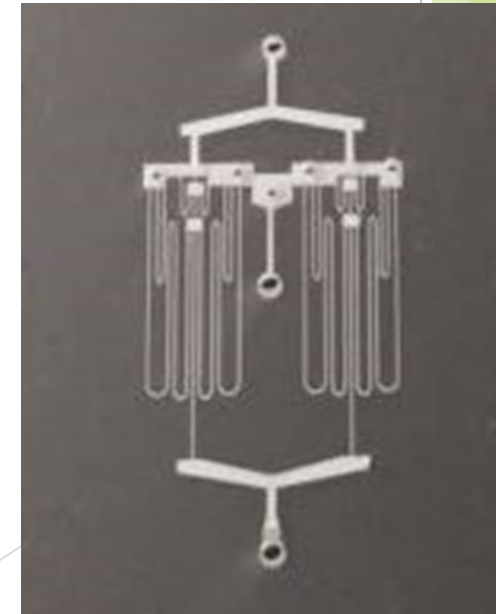
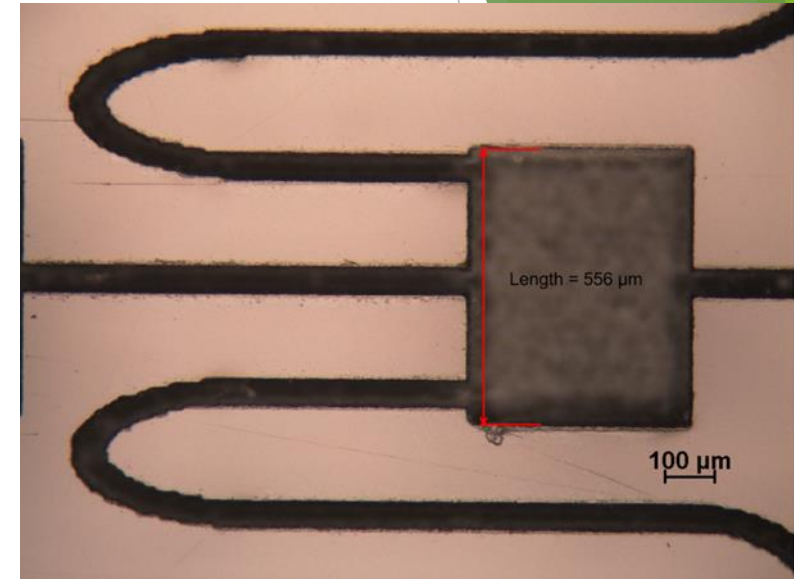
POLYMERIC LAB ON A CHIP

- ▶ Materials : silicon & glass
- ▶ polymeric materials : low price, pre-sterilized, usable in any environment
- ▶ Polymethylmethacrylate (PMMA) : excellent mechanical, optical, chemical properties



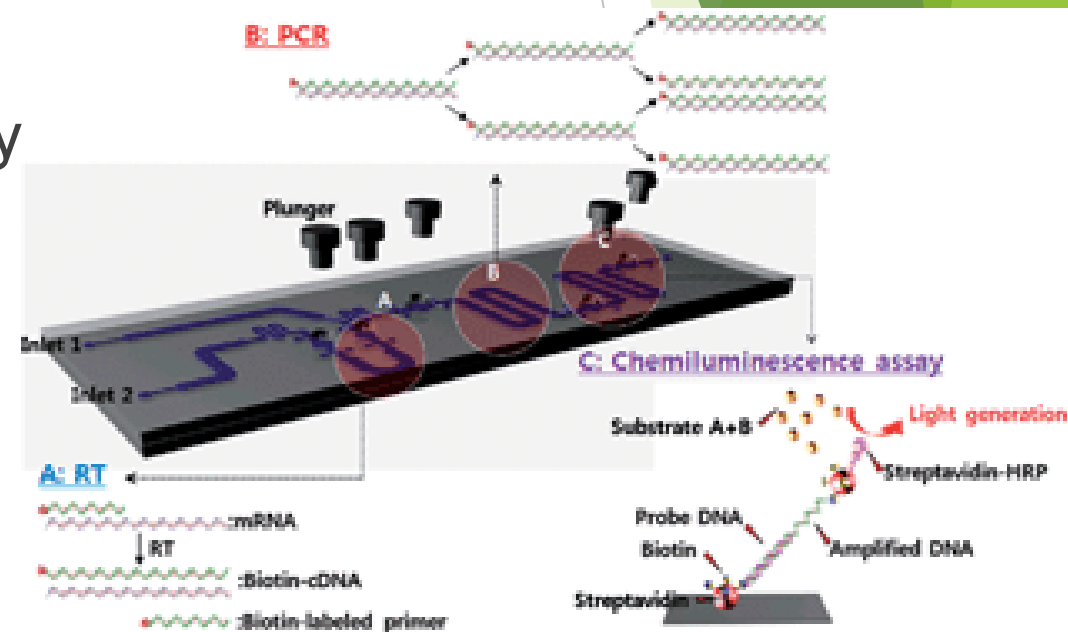
FEMTOSECOND LASER TECHNOLOGY FOR LAB ON A CHIP

- ▶ Rapid prototyping by direct laser ablation
- ▶ Micrometric precision
- ▶ “Cold ablation” minimum thermal induced deformation
- ▶ possibility of sealing the channels by direct fs laser bonding of transparent polymers



Case study: DNA EXTRACTION

- ▶ Phases into a single chip : extraction, amplification, analysis
- ▶ Twofold advantage : reduce sample contamination, increase device portability
- ▶ Application : clinical and veterinary diagnostics, industrial, agricultural, forensic sciences



DOCTORAL ACTIVITY

1st YEAR :

- ▶ Literature review on the state-of-the-art of
 - ▶ Laser ablation of polymers
 - ▶ Polymeric LoC fabrication technology
 - ▶ LoC for DNA extraction
- ▶ A first layout of the device for DNA extraction will be designed (jointly with ST Microelectronics Lecce)
- ▶ Experimental Parametric study of fs laser milling of PMMA

DOCTORAL ACTIVITY

2nd YEAR:

- ▶ Fs laser fabrication of first LoCs prototypes for DNA extraction
- ▶ First Device testing at ST Lecce
- ▶ Implement the microvalves, micro pumps and other accessories needed for the perfect functioning of the devices in the prototypes

DOCTORAL ACTIVITY

- ▶ Interface new prototypes with existing devices for amplification and DNA analysis
- ▶ Planned secondment at Strathclyde University, Glasgow (UK) (supervisor: Prof. Michele Zagnoni)
- ▶ Optimizing the design and testing of the first chips with biological samples.

3rd YEAR :

- ▶ Manufacture, assembly and validation of the final device

THANK YOU

The background features abstract, overlapping geometric shapes in various shades of green, ranging from light lime to dark forest green. These shapes are primarily located on the right side of the frame, creating a modern, layered effect against the white background.