
micnola
OPTOELECTRONICS
laser sources and optoelectronic devices

Stereolithography and nano-filled materials: let's talk about 4D printing

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microla OPTOELECTRONICS

Born in **2006** as **Spin-Off** of

Politecnico di Torino

Administration and offices 250 m²

Laboratories and facilities 300 m²

Full time people employed 8

Consolidated Turnover more than 600k€

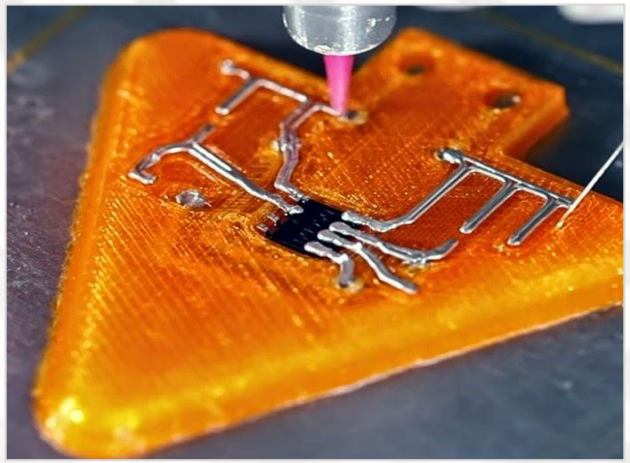
Microla represents a reference in the fields of optical design and processes by laser micromachining.

Introduction

4D printing is: creating objects with **advanced materials and innovative processes**

Self assembling structures

Embedded optics

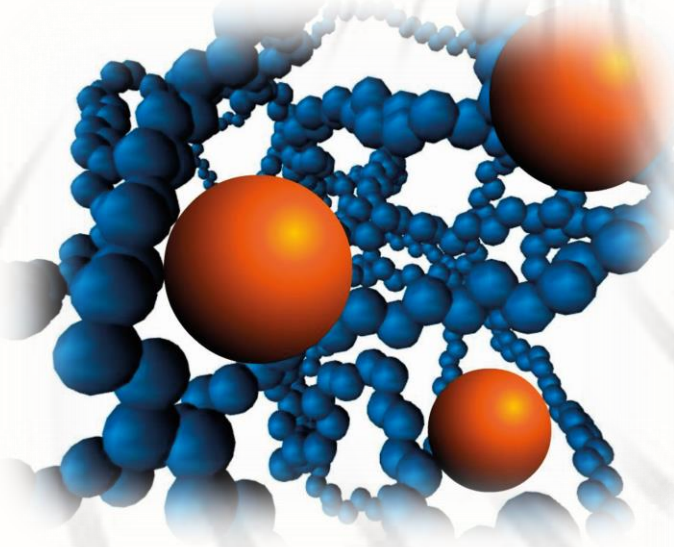


Embedded electronics

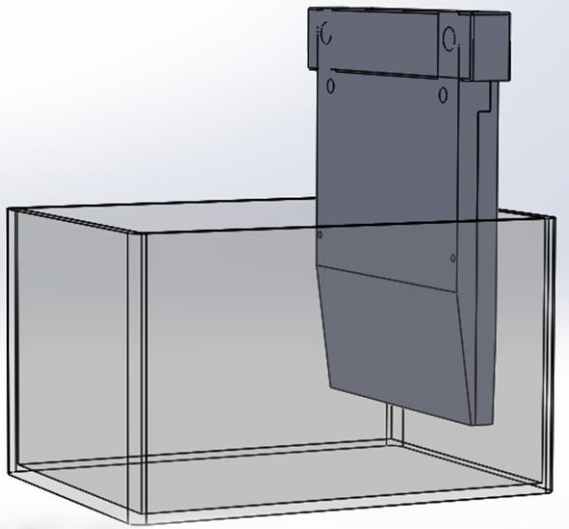
Introduction

4D printing is: creating objects with **advanced materials** and **innovative processes**

CONDUCTIVE POLYMERS



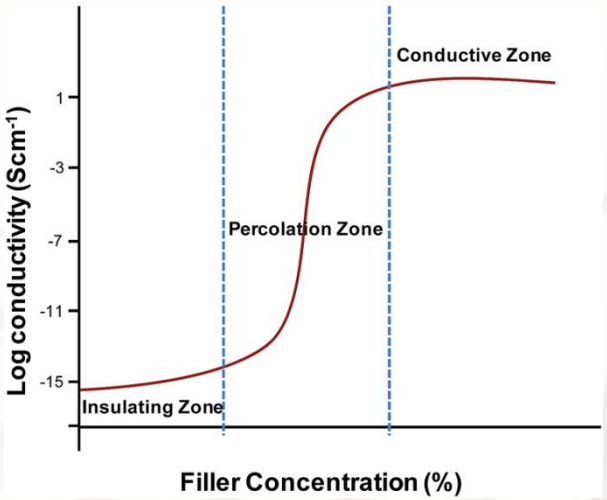
FILM DEPOSITION IN STEREOLITHOGRAPHY



Introduction

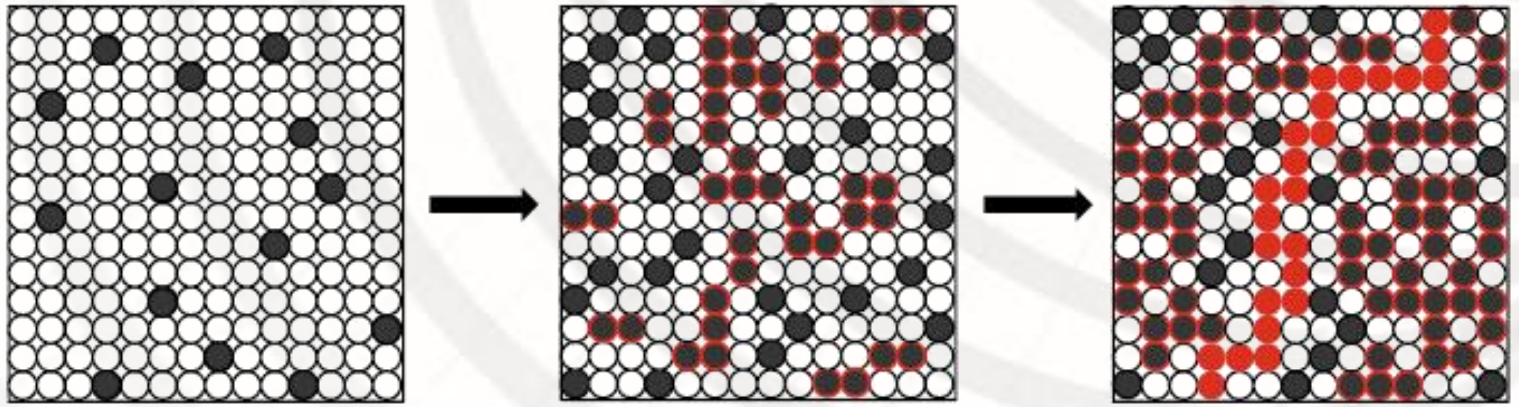
Conductive polymers

4D printing is: creating objects with **advanced materials** **and innovative processes**

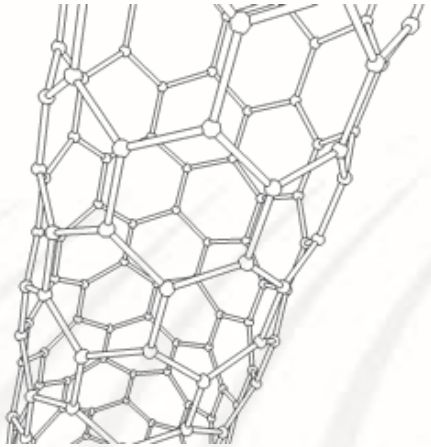


Extrinsically conductive polymers

In order to be conductive, particles dispersion must reach percolation threshold.



4D printing is: creating objects with **advanced materials** and innovative processes



Our nano-filler: carbon nanotubes

length/diameter=10^4

external diameter= 0.7-100 nm

Properties:

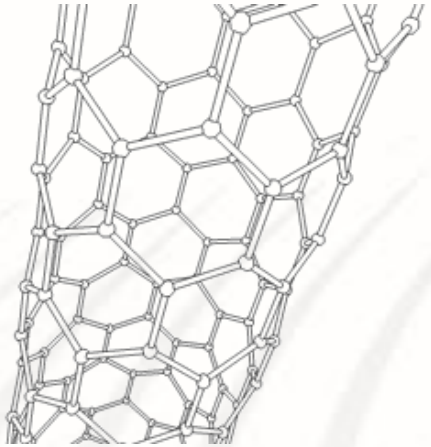
- High thermal conductivity
- High electrical conductivity
- Strong mechanical properties

	Thermal conductivity [W/mK]	Electrical conductivity [S/m]
Carbon nanotubes	>3000	10^6 - 10^7
Copper	400	$6x10^7$

fascio di SWNT	563	~150	1.3
Grafite	350	2.5	2.6
Acciaio	208	0.4	7.8

J. Lu and J. Han, Int. J. High Speed Electron. Sys. 9, 101 (1998)

4D printing is: creating objects with advanced materials and innovative processes



Why carbon nanotubes?

Current / Short-term	Mid-term	Long-term
Conductive polymers & composites (automobiles and electronics)	Coatings (conductive thin films)	Microwaves antennas
Sensors and Instruments (microscope probe tips, gas leak detectors)	Catalysts (petrochemical)	Seld-assembling yarns
Electromagnetic Shielding	Textiles & fibers	Aerospace
Sporting goods (tennis rackets)	Lithium ion batteries	Medical implants
	Membrane and filters	Drug delivery
	Lamps	
	Semiconducting materials	
	Advanced ceramics	
	Fuel Cells	
	Caulks and sealants	

Figure 2: Key potential applications of MWCNTs on the short, mid and long-term.

Introduction

Conductive polymers

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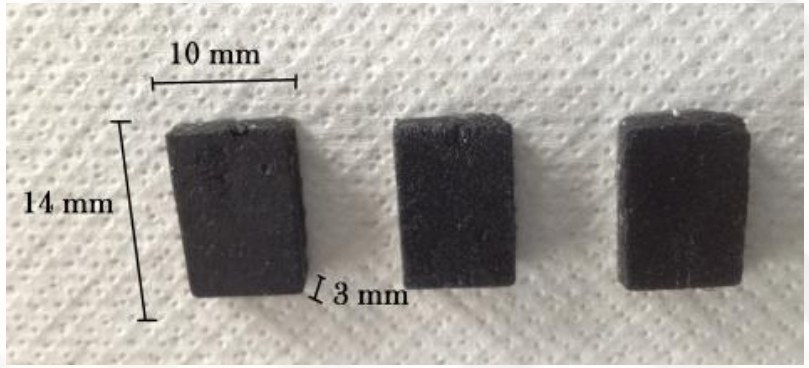
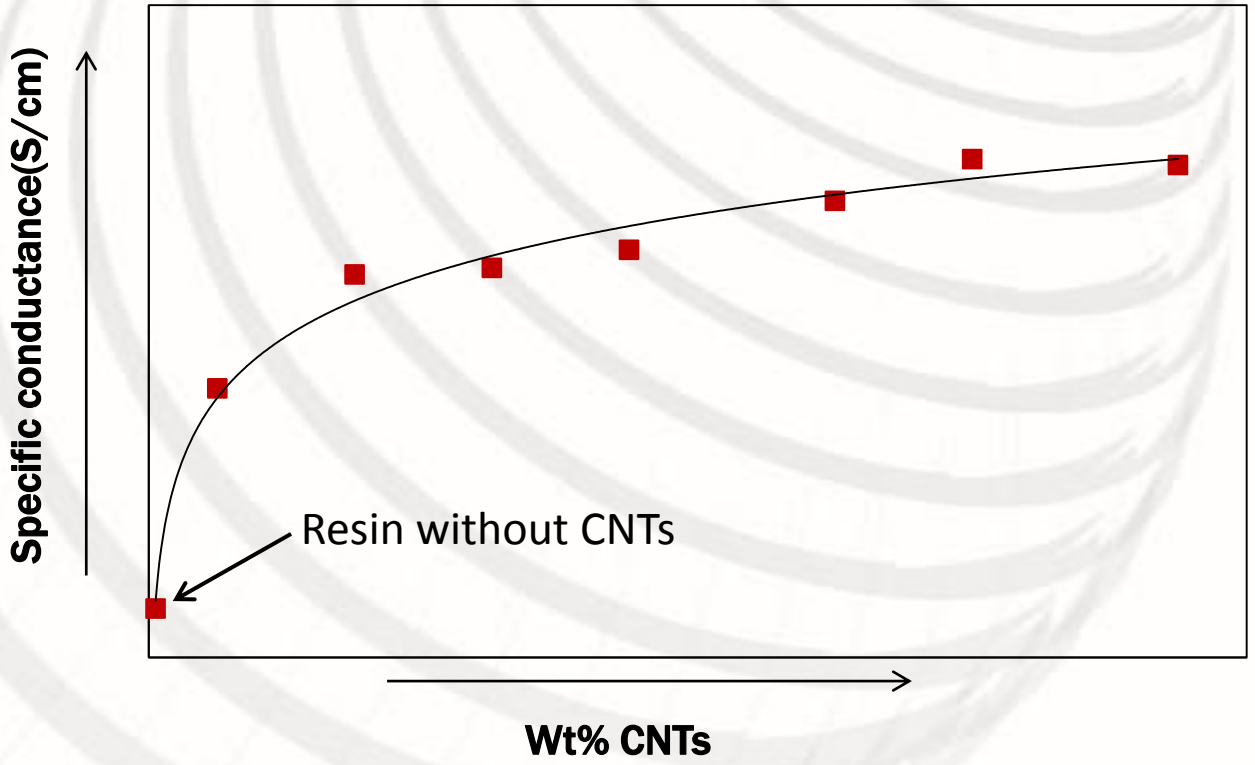
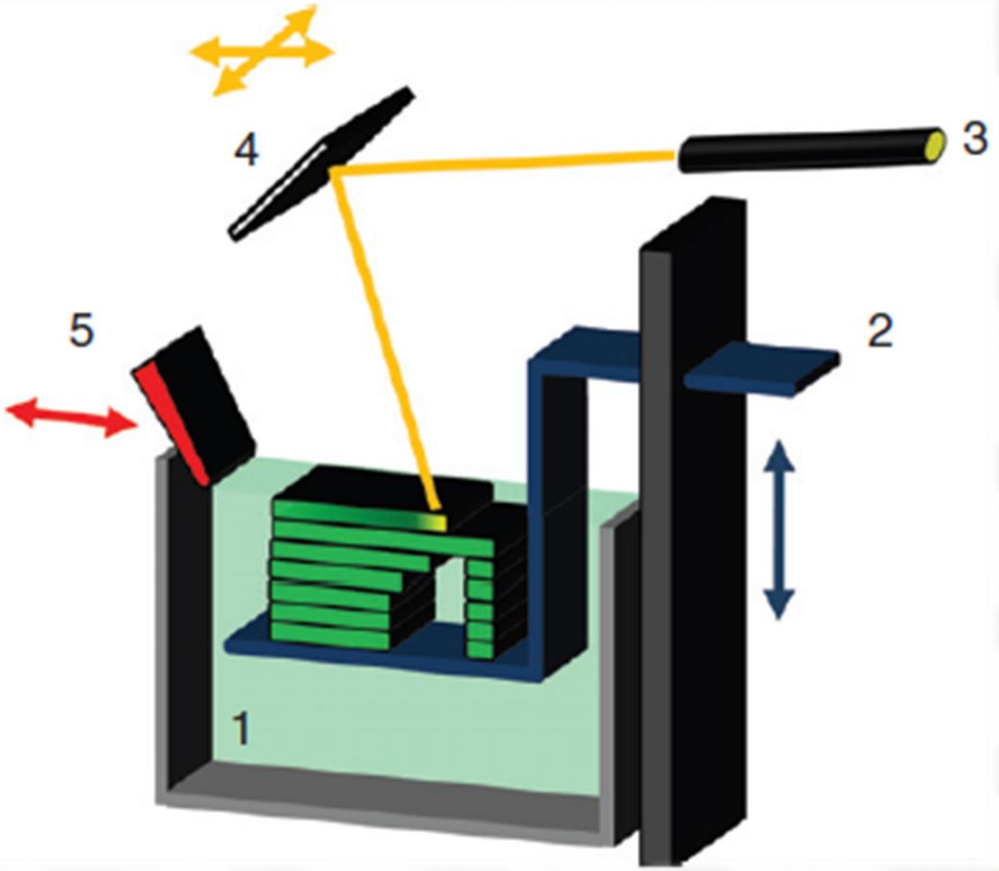
Results:





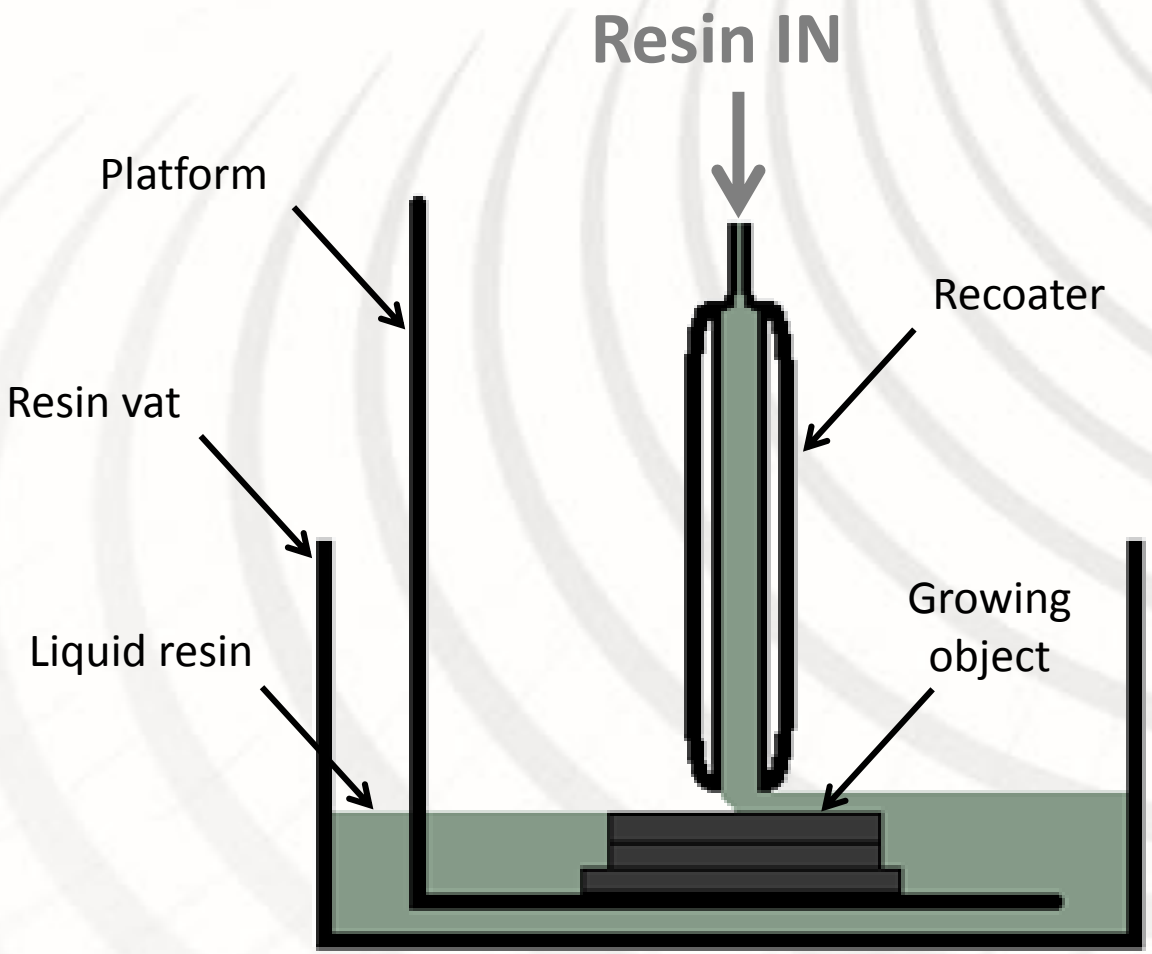
To be published soon

4D printing is: creating objects with **advanced materials and innovative processes**



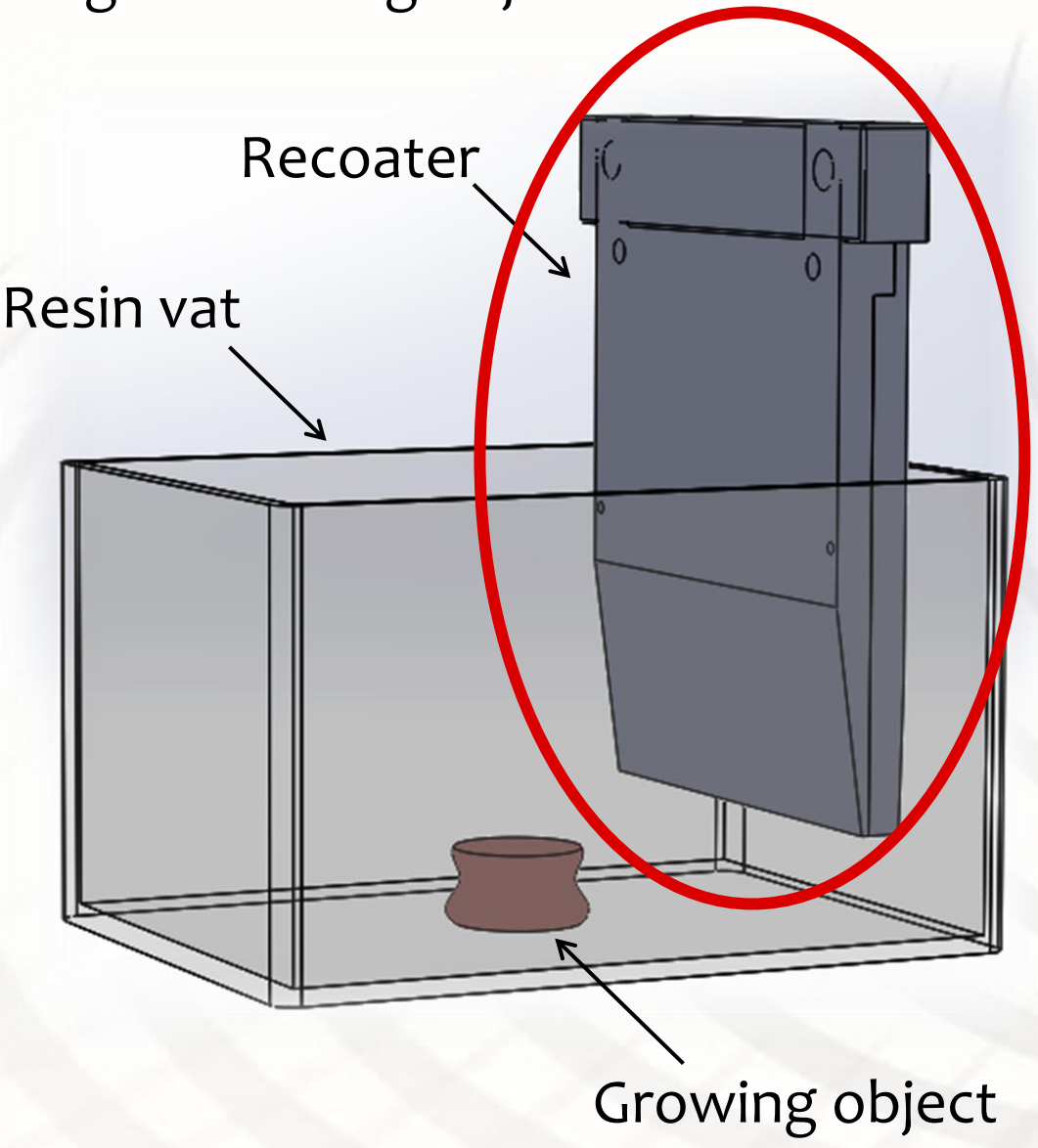
Stereolithography process

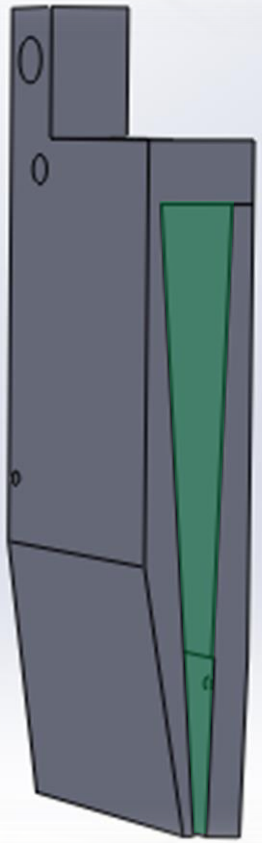
4D printing is: creating objects with **advanced materials and innovative processes**



Film deposition

4D printing is: creating objects with **advanced materials and innovative processes**

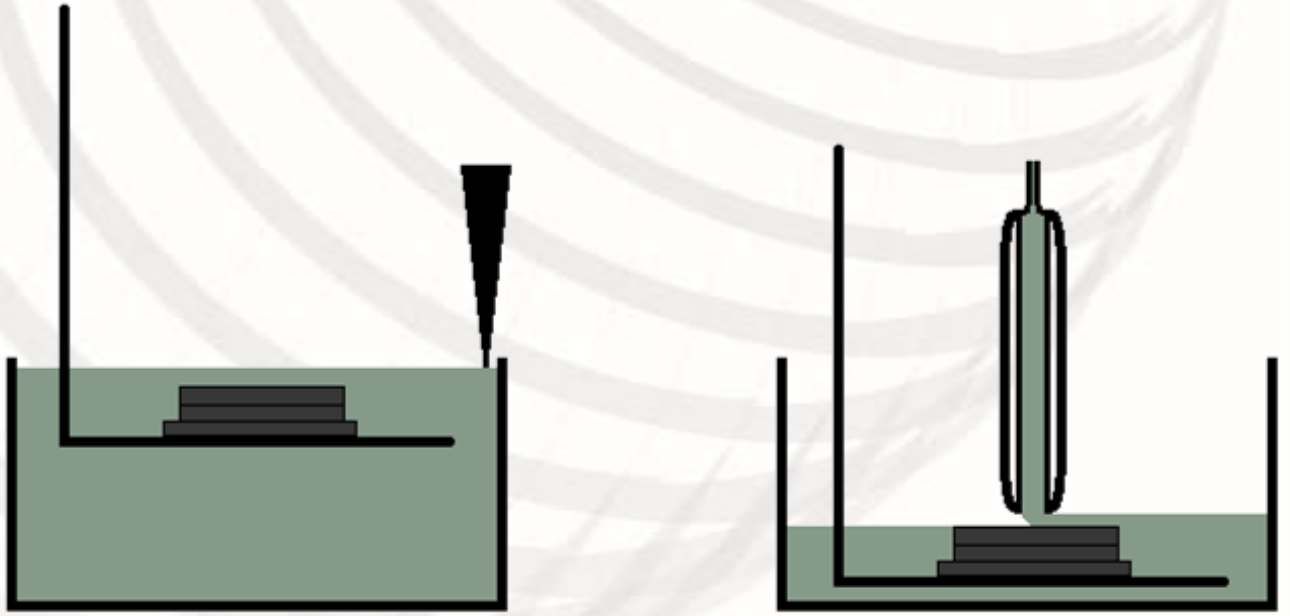




4D printing is: creating objects with **advanced materials and innovative processes**

Advantages:

- Less material consumption
  - The recoater holds minimum resin quantity
  - The resin reservoir feeds directly the recoater
  - Simple resin recovery at the end of process
- Accurate recoating
- Faster process



Future perspectives

Finding optimal printing parameters

Multi-material stereolithography

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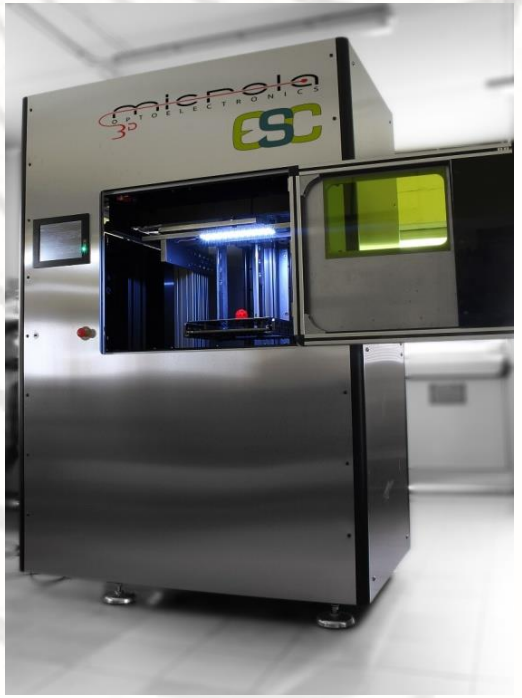
Embedded micro/nano electronics with our printer and polymers!



We will be on the market as soon as our 4D printer will be ready!

Thanks for your kind attention!

Images and informations:

www.selfassemblylab.net
www.voxel8.co
www.cefic.org

Speaker: Valentina Bertana
valentina.bertana@polito.it

Paper: "Printed optics: 3D printing of embedded optical elements for interactive devices", K.Willis, E. Brockmeier, S.Hudson, I.Poupyrev.

Paper: "Electrically conductive polymers and composites for biomedical applications", Gagan Kaur, Raju Adhikari, Peter Cass, Mark Bown and Pathiraja Gunatillake.