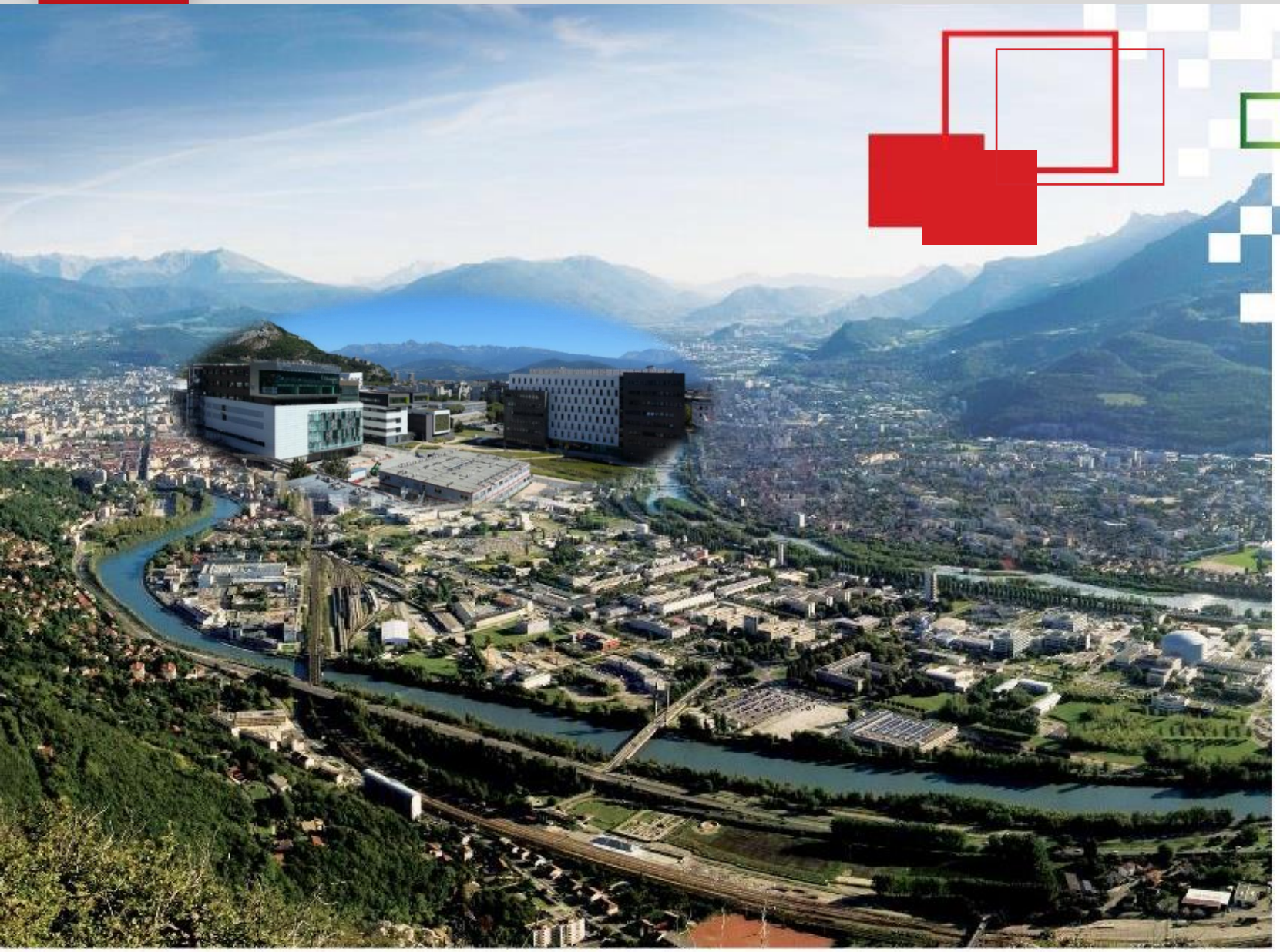
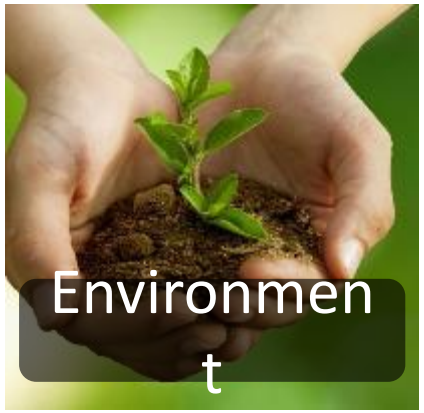
LETI, FOR 54 YEARS, THE PLACE TO BE TO INVENT TOMORROW



- Since **1967**
- France, USA, Japan
- **2,000** People
- **> 2,760** Patents in Portfolio
- **350** Industrial Partners
- **> 65** Startups Created
- **10,000 m²** Cleanroom 200-300mm
- **315 M€** Budget
  (**85%** from R&D contracts)

A MARKET APPROACH WITH EMBEDDED & MINIATURIZED INTELLIGENCE



MICROLED FOR IMAGE DISPLAYING

- Displays:
  - LCD, OLED, …
  - TFT technology

New: microLED technology for displays:
- Better image quality
- Lower energy consumption

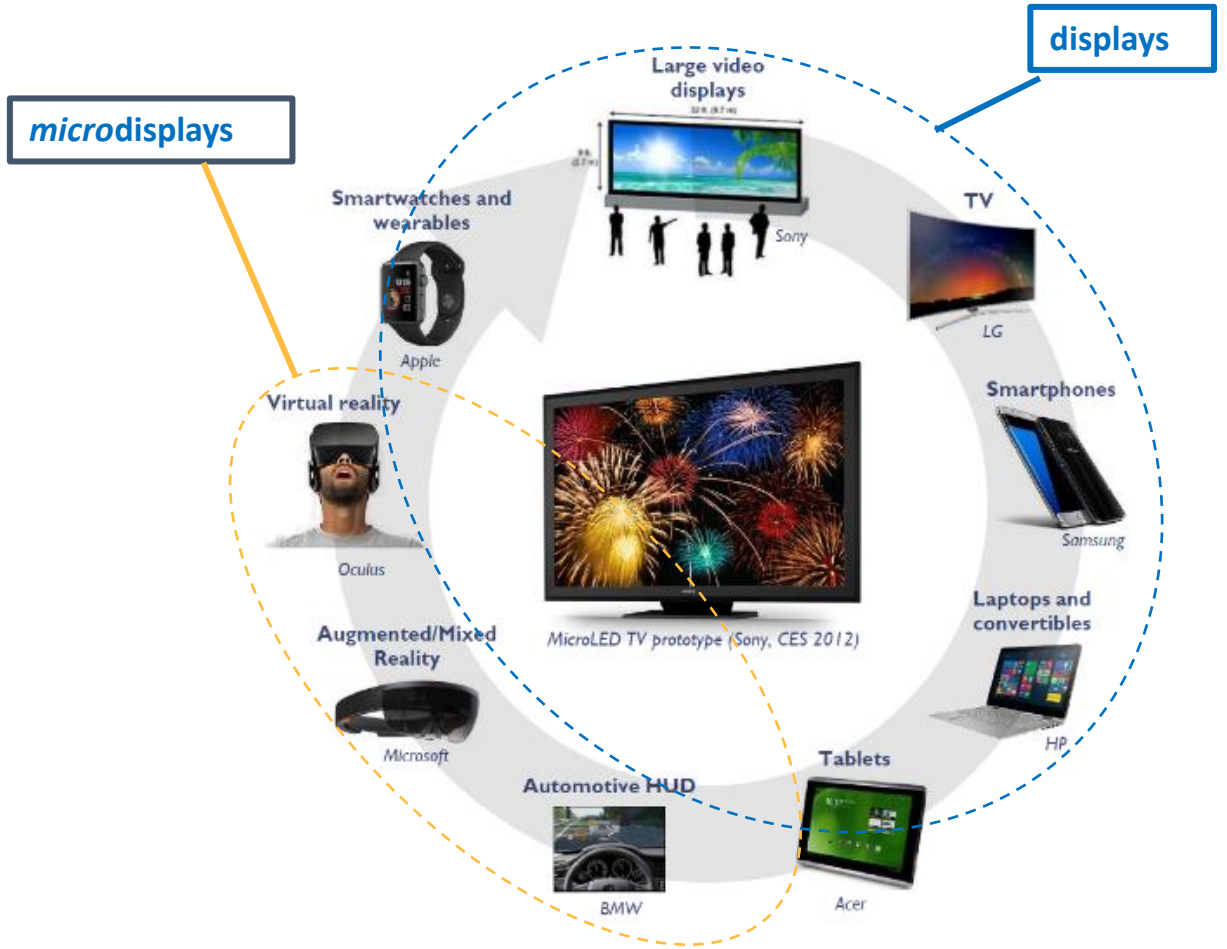
→ Will bring revolution in both displays worlds!

	Smartwatch	Smartphone	Laptop and tablets	TVs
Energy consumption	5	4	4	1
High Pixel Density	2	2	1	1
Color Gamut	2	2	3	5
Brightness	5	4	3	4
Contrast	3	3	3	5
Refresh rate	1	1	2	5
Long lifetime	1	1	2	2
Flexible	3	3	0	0
Overall attractivness	22	20	17	23

(1): expect longer use periods than VR

1 - Not very important or differentiating
2 – Important
3 – Very important

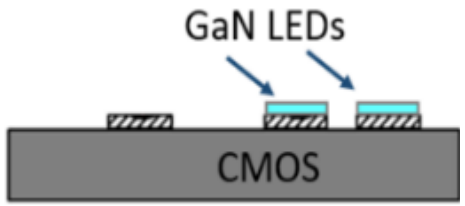
YOLE

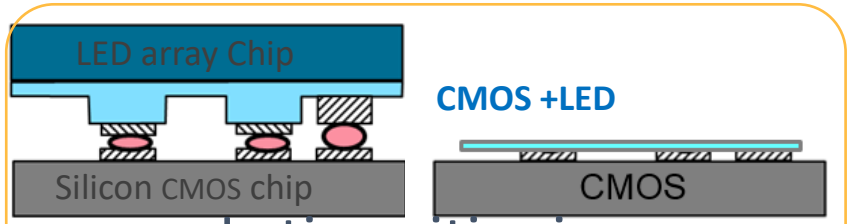


MICRODISPLAY WITH MICRO-LED APPROACHES @ LETI

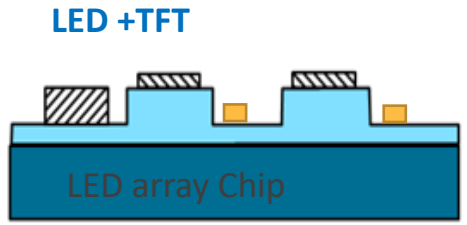
High brightness microdisplay required the integration on LED and transistors.
There are different methods for integration

1) Hybridization / 3D integration:





2) Monolithic:

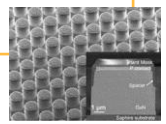


Leti positioning

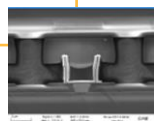
micro-led Platform

- Epitaxy on patterned substrates & native color

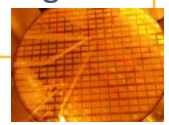
- LED array process pixelization



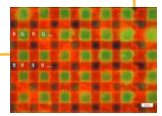
- 3D integration technique of LED arrays on CMOS



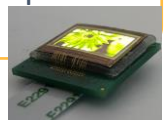
- IC silicon active matrix for LED driving



- QDs and nanophosphors 2D layers

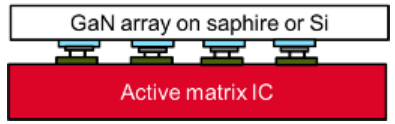


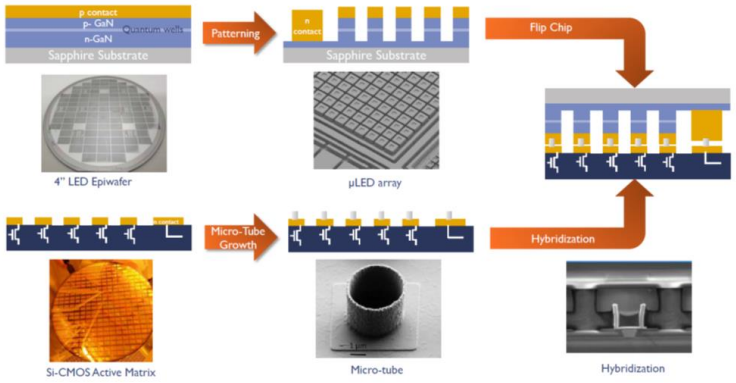
- Curved display to simplify the optics

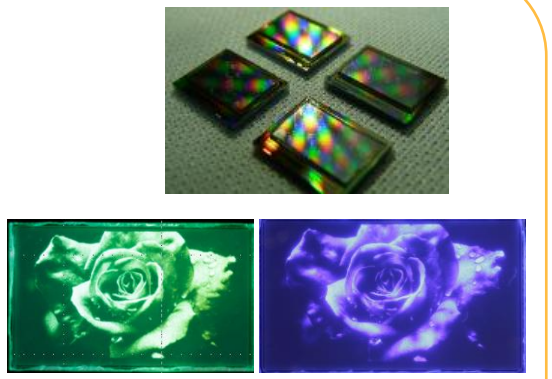


LED MICRODISPLAYS DEMOS@ LETI

❶ Hybridiation



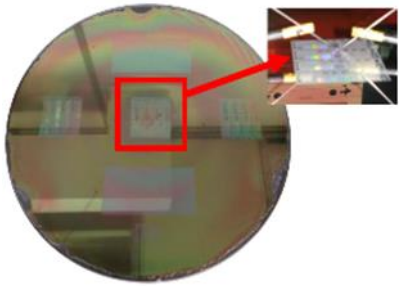


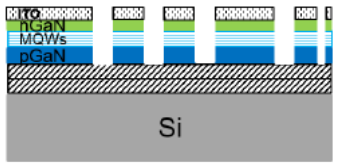


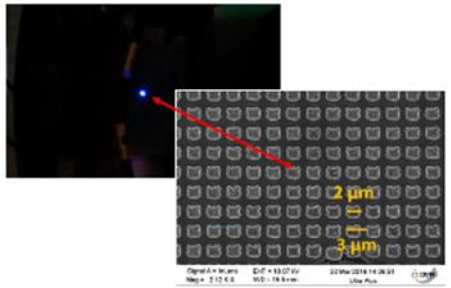
WVGA (873 x 500) at 10 µm pitch video

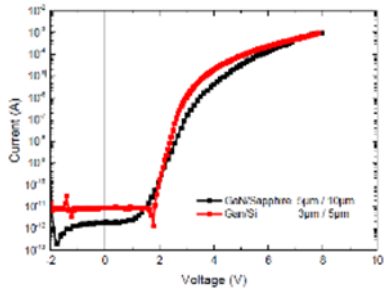
❷ Monolithic

CMOS +LED









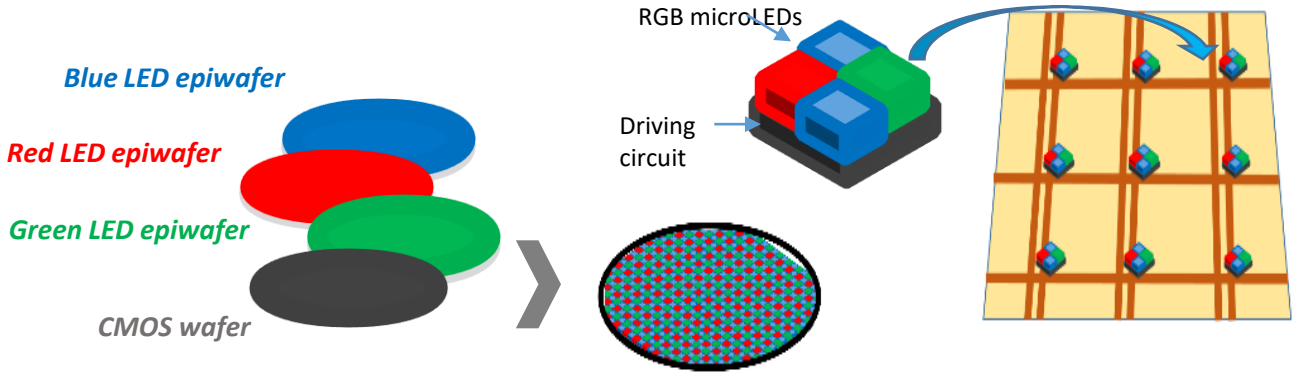
Best paper award IDW'16 Fukuoka

Proof of concept done

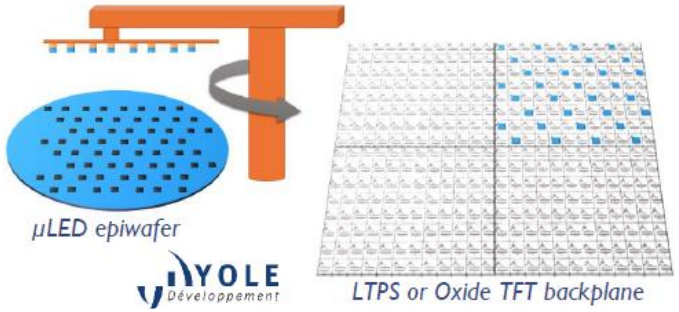
- MicroLEDs operate after transfer process and post processing (patterning)
- Record pixel-pitch GaN microLED array (3 µm)
- Good Electrical characteristics

Large surface display base on µLED

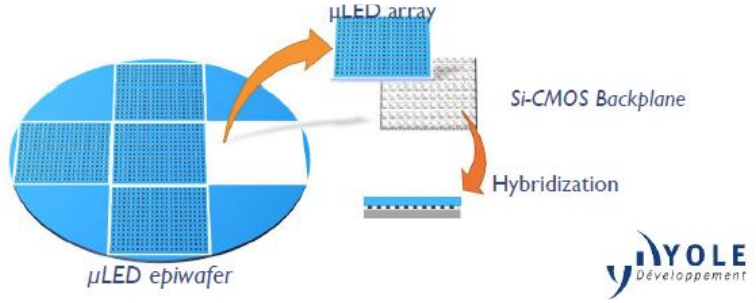
Screen Dimensions



Smartpixel (CMOS+µLED)
- → **Removal of TFT backplanes**
- → **Large backplane, no Si**
- → **High functionality (CMOS-integrated)**



TFT Backplane
- → ***Large dimension***
- → ***<u>No longer</u> TFT-limited***



Si- CMOS Backplane
- → ***High density & functionality***
- → ***small dimension***

Functionality increase

FIRST RESULTS

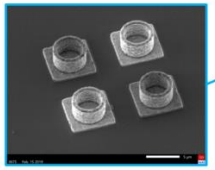
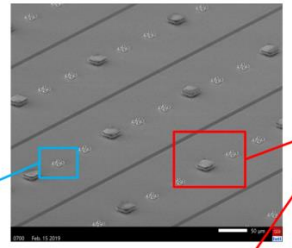
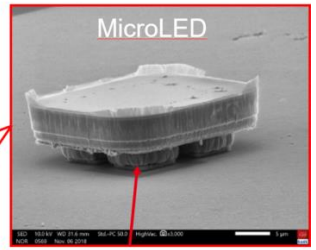
What was done

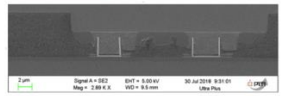
1- Blue, green and red microLEDs "chips"

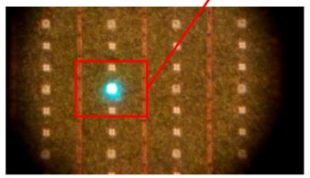


First red microLED at LETI

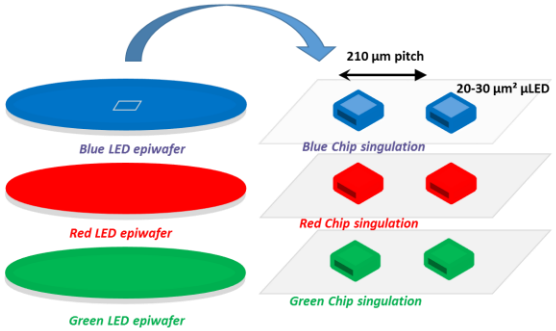
2- transfer of Blue and Green micro leds on support, contact by microtubule

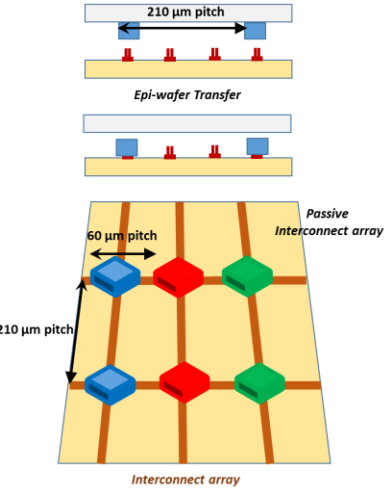




Microtube interconnections




First blue and green microled proto display connected by microtube





Under development:

-Red assembly

- Assembly of two or three successive colors

Thank you

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