

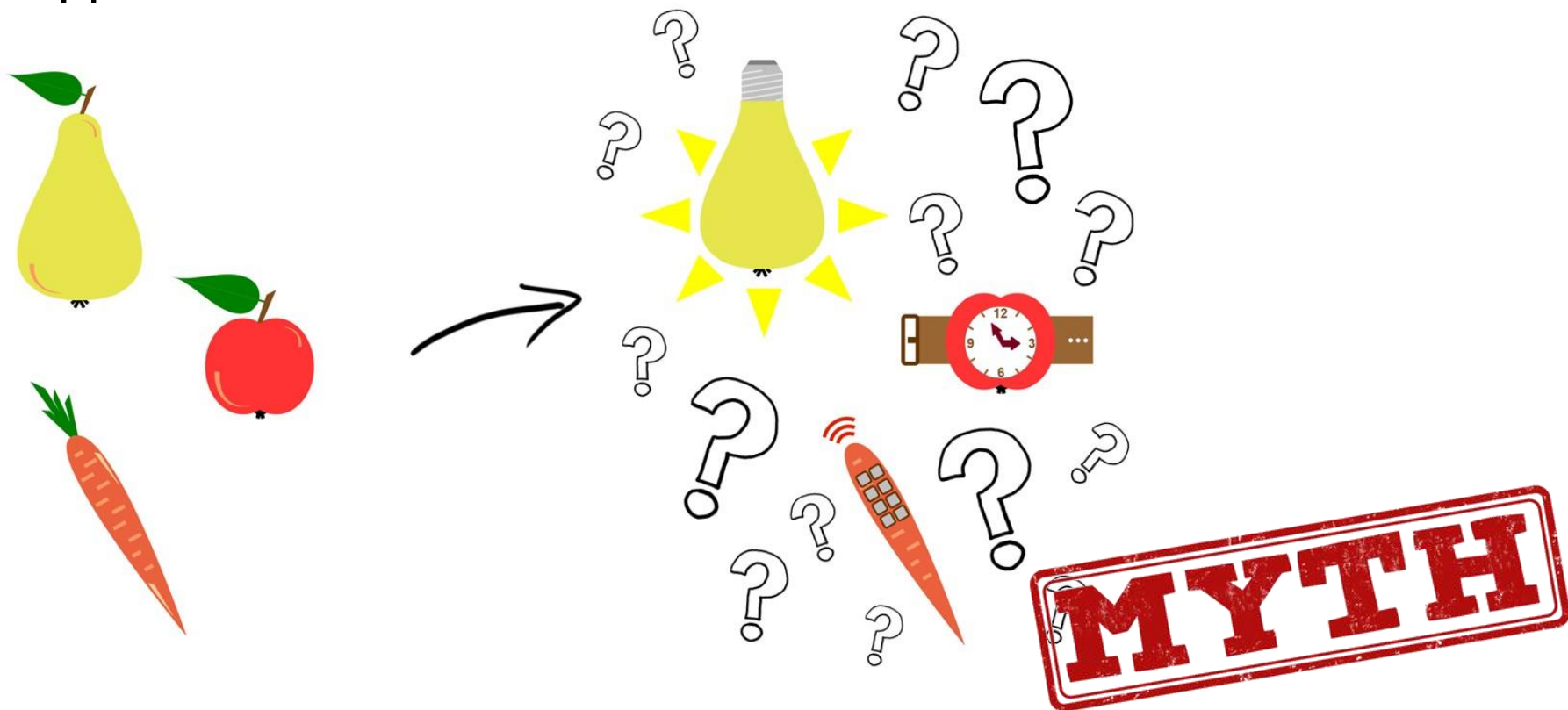


Organic Electronics

Short introduction

What is „organic electronics“ ?

- definition: Application of organic materials for electronic application



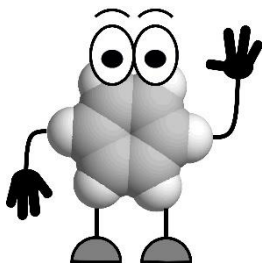
What is „organic electronics“ ?

- definition: Application of organic materials for electronic application
- All nature-inspired molecular materials are prepared in the lab by chemists

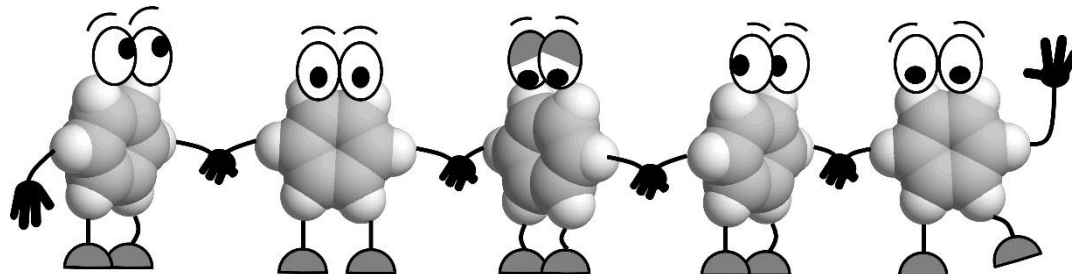


TRUE

Small molecules



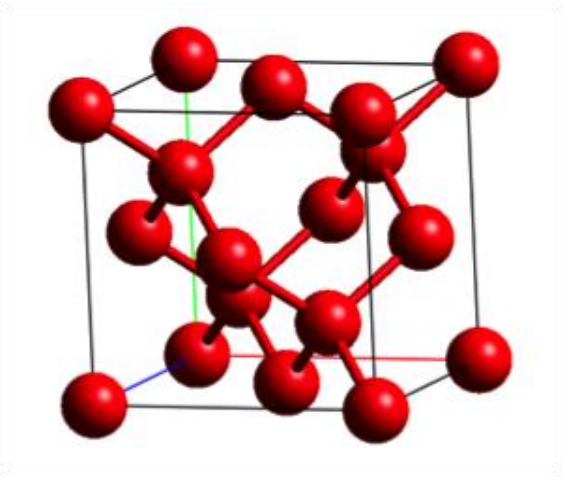
Polymers



Semiconductors

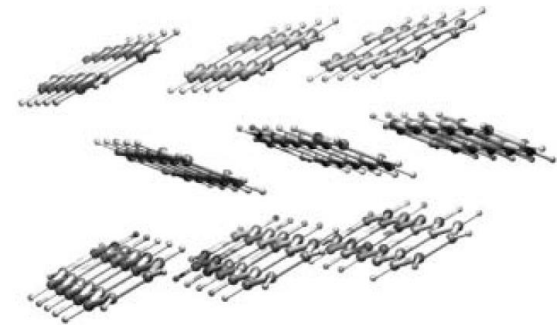
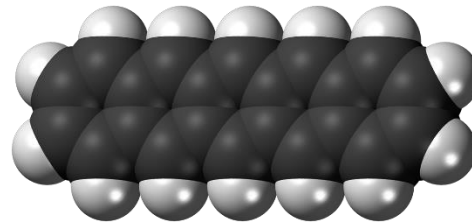
Inorganic

- Si and others
(GaAs, InP, GaN, ...)
- Covalent bond between atoms



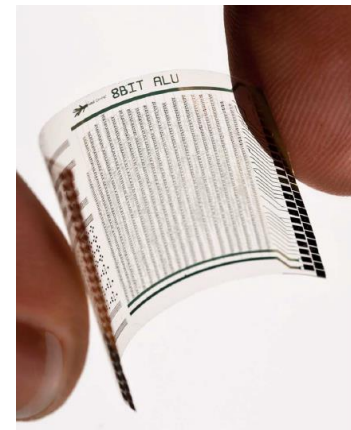
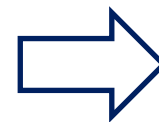
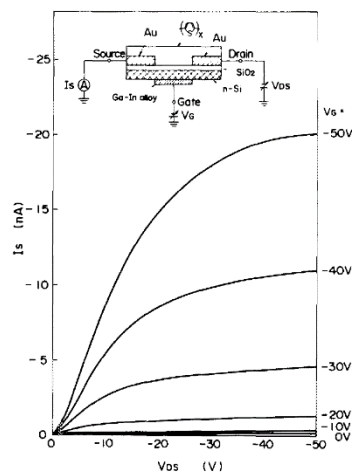
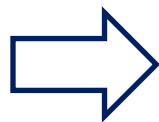
Organic

- Small molecules or polymers
- Molecular crystals
(weak van der Waals only)



How it started?

- 1970's: MacDiarmid, Heeger, and Shirakawa discovered “conductive polymers” (Nobel prize in 2000)



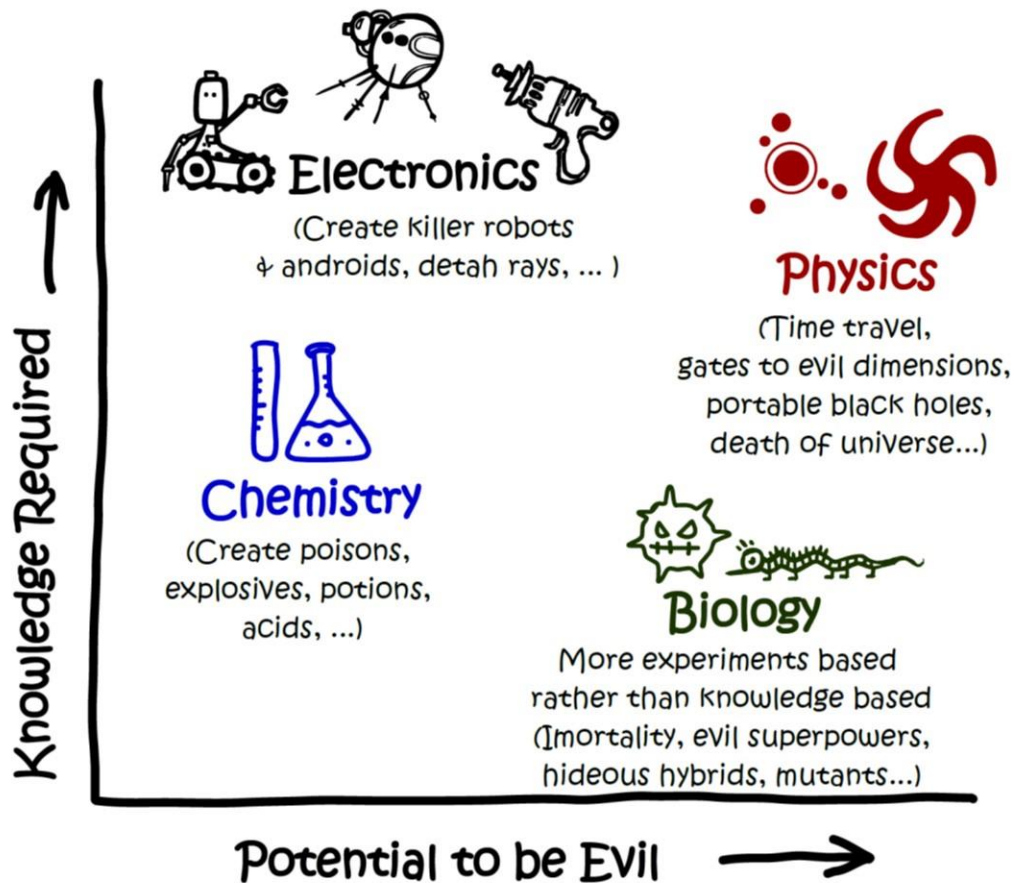
It is not chemistry only !

- Organic electronics combines physics, chemistry, electronics, and biology - strong *Interdisciplinary* nature...
- Why it is so important? Because we can combine the best!



Interdisciplinary nature...

What to study?
(if you want to become an Evil Scientist)



Motivation: Why Organic Electronics ?

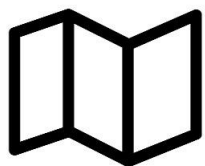
Wish-list of Organic Electronics

(everyone has different expectations)



Motivation: Why Organic Electronics ?

Properties



Foldable

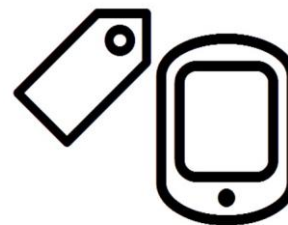


Low costs

Extraordinary Applications



Wearables



SMART Tags

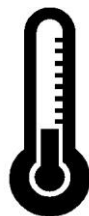


Sensors

Fabrication technology



High
Yield



Low
temperatures



Inkjet
printing



High
Mobility



Long
Lifetime

Electrical properties

Consumer

Manufacturer



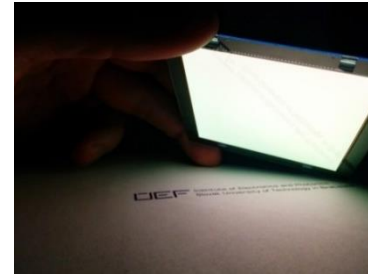
Elektronic devices

(and applications)

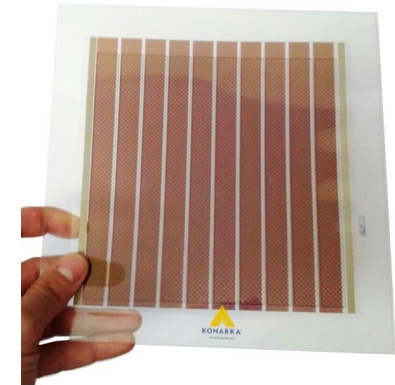


Examples

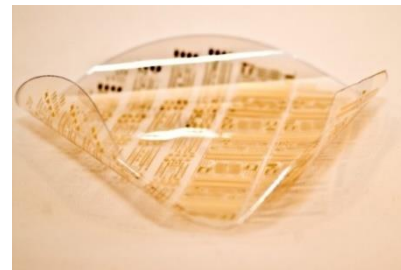
- OLED displays and lightings.



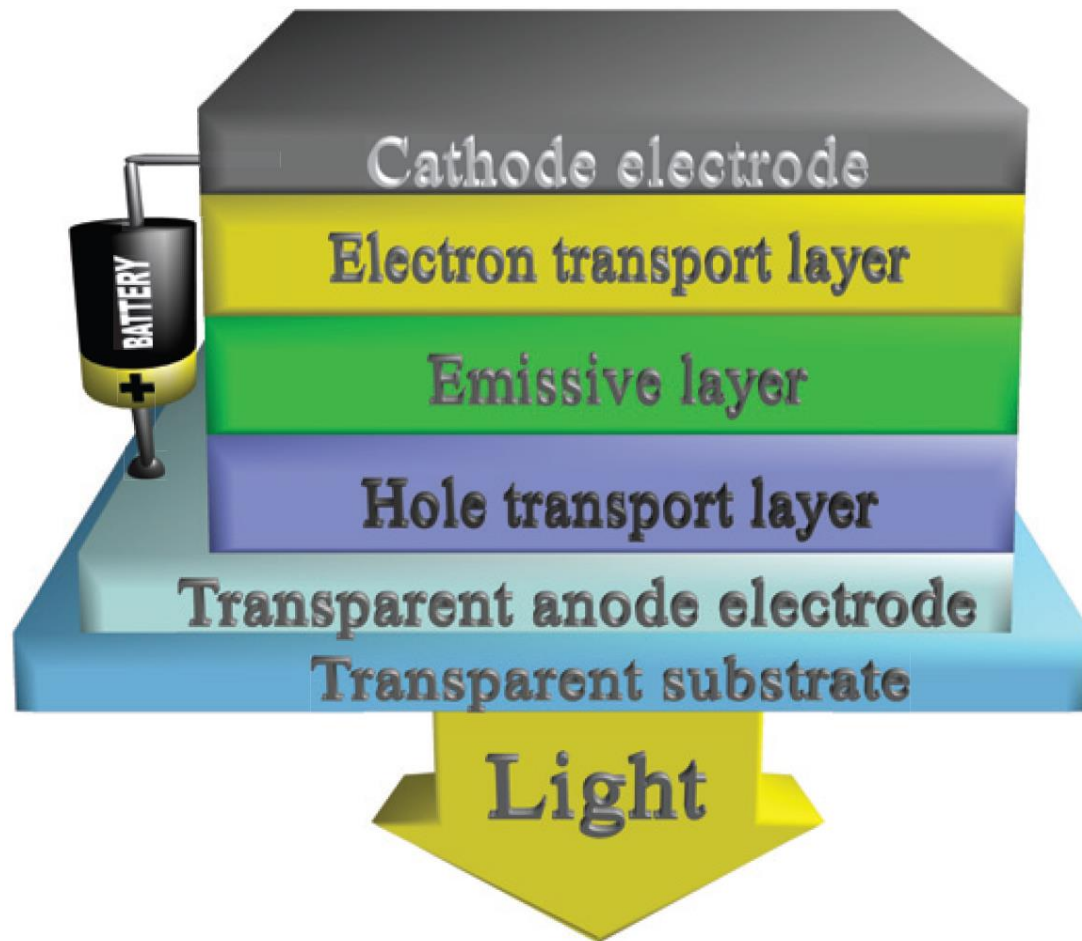
- Organic solar cells and photodetectors.



- Organic memories and transistors.
RFID a SMART sensors.

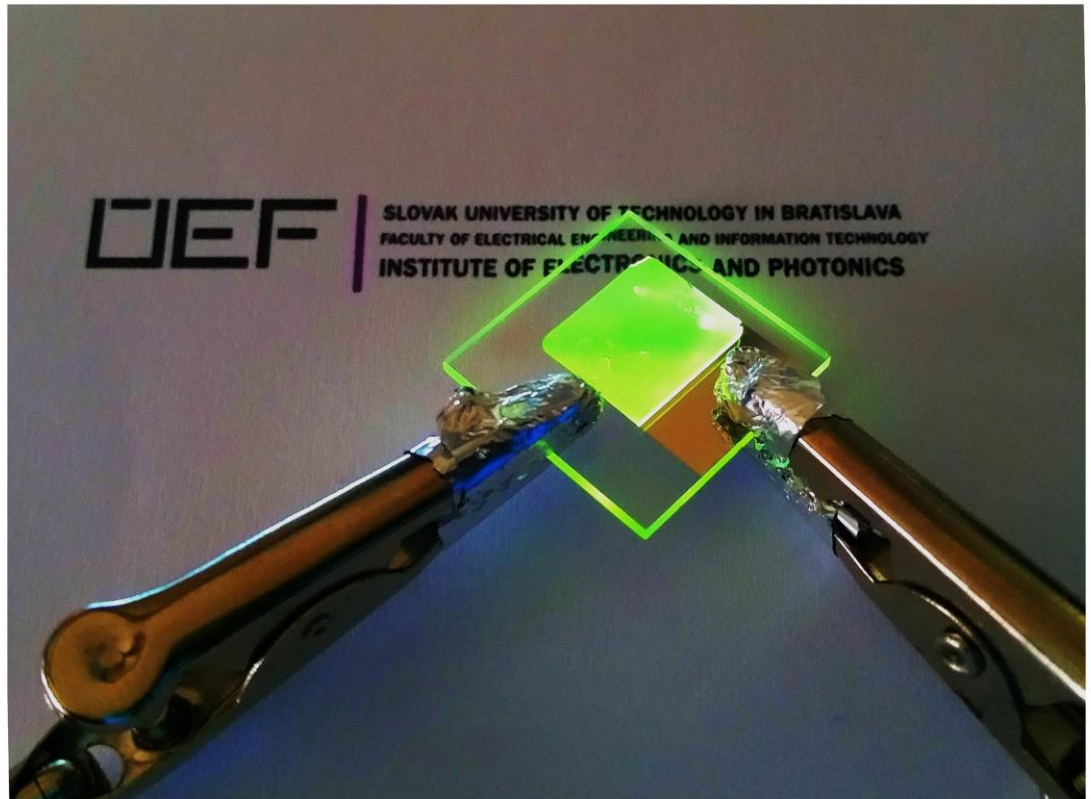
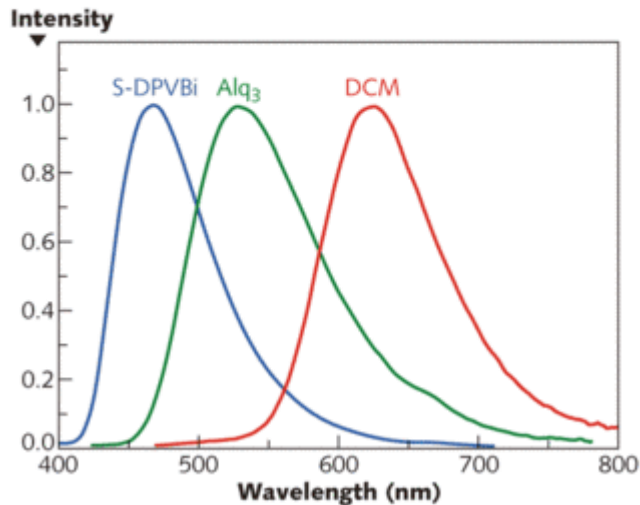
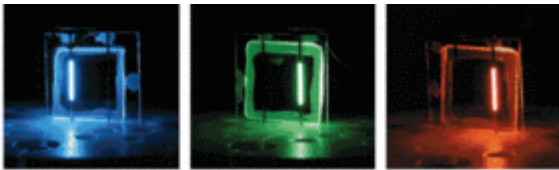


OLED structure



OLED

- OLED: organic light-emitting diode
- Organic layer(s) sandwiched in between electrodes



OLED displays



Sony



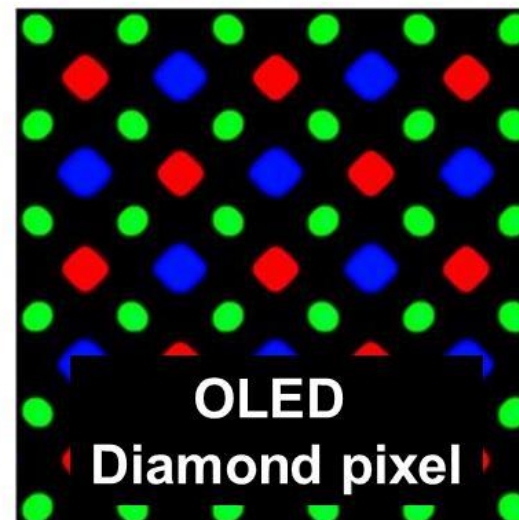
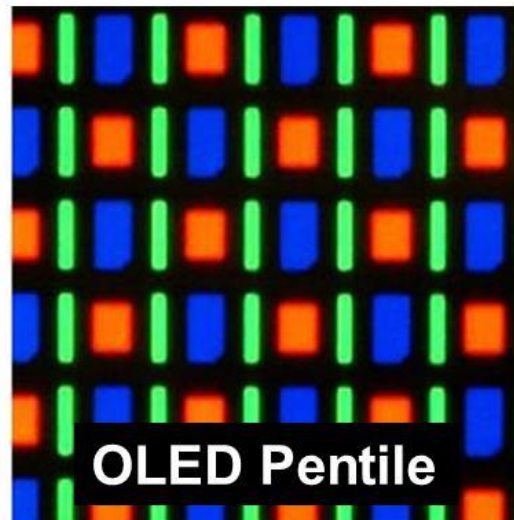
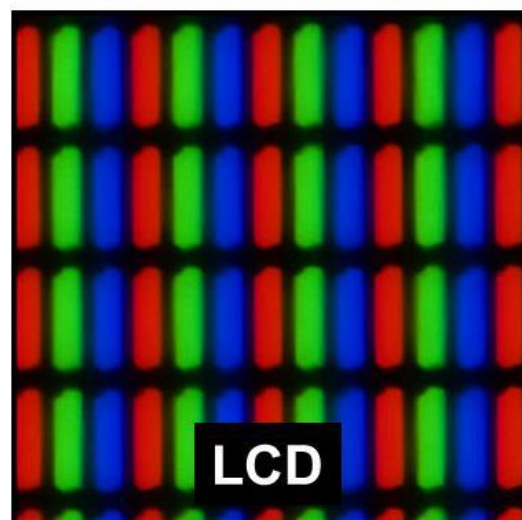
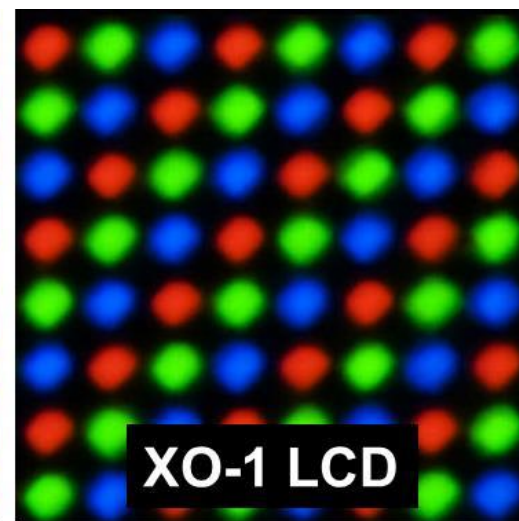
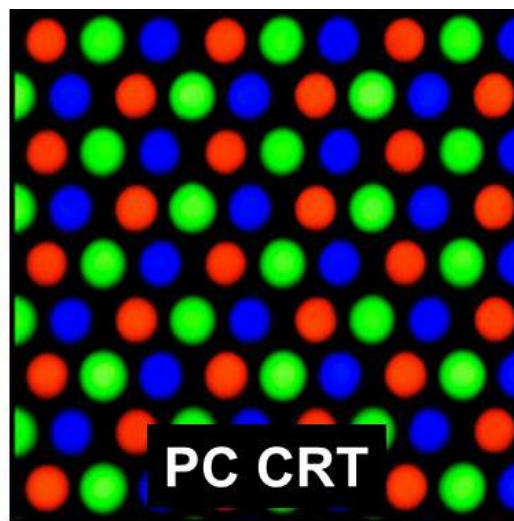
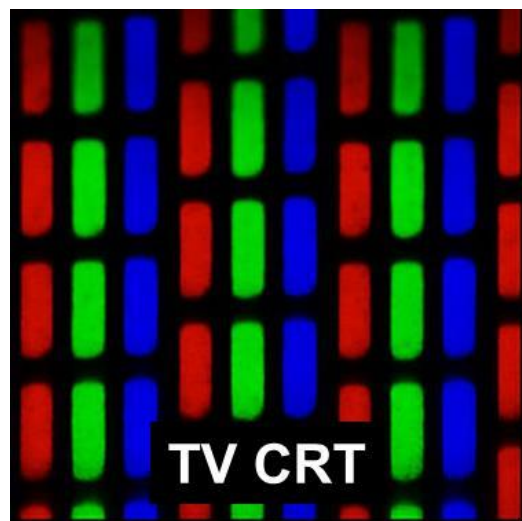
LG



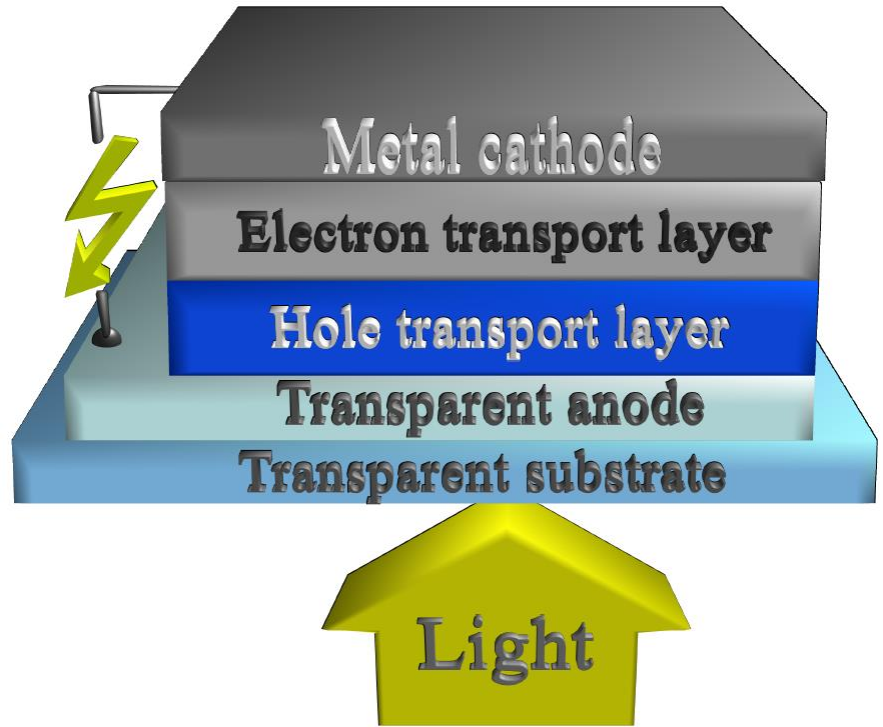
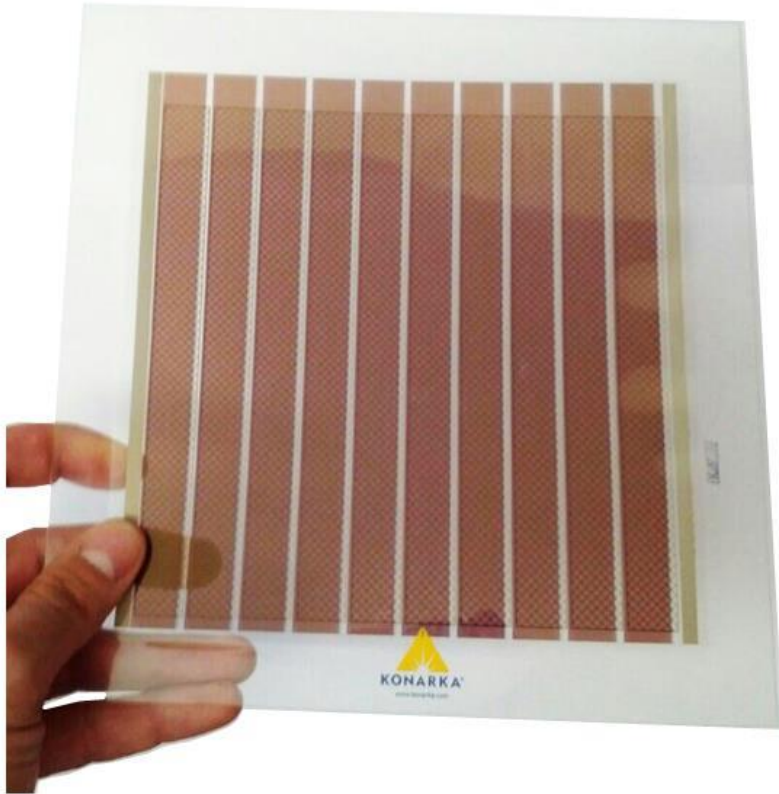
Samsung



Pixel evolution

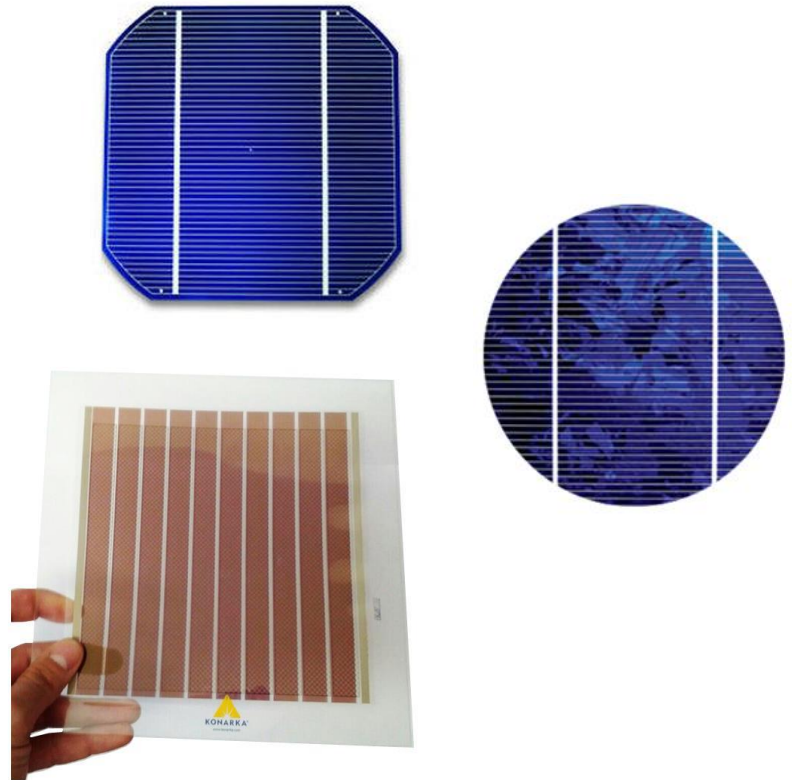


Organic solar cells



Comparison

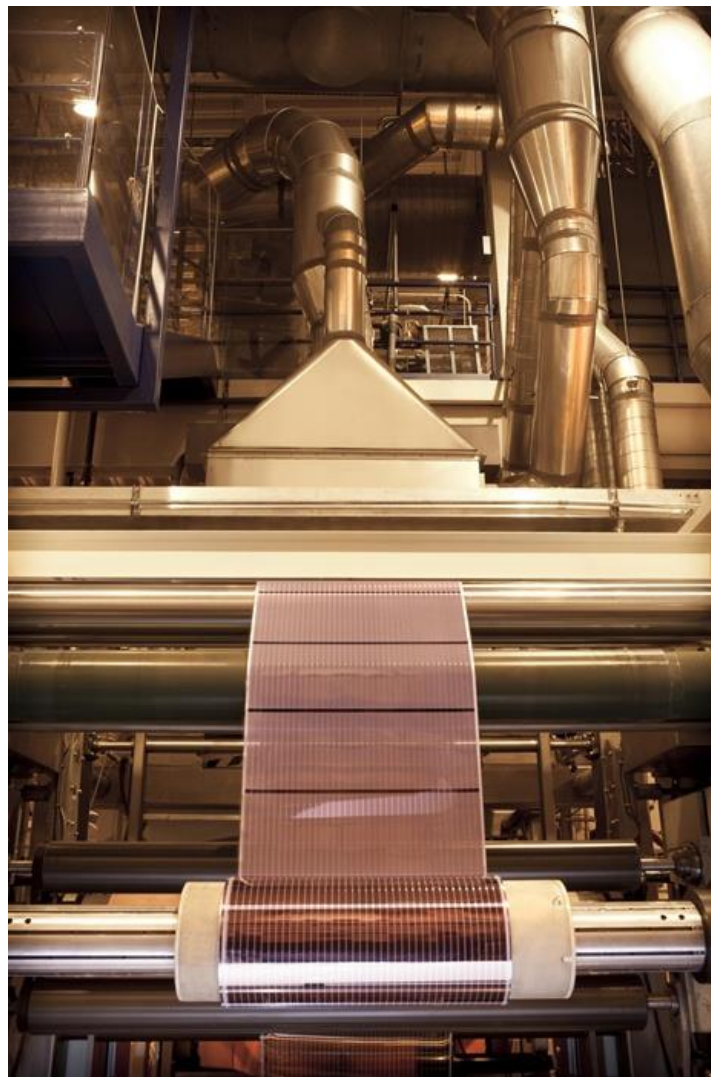
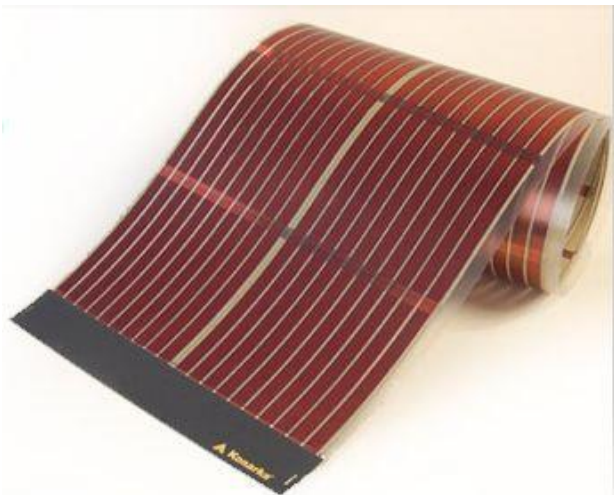
- Monocrystalline silicon: 25%
(GaAs 26.4%)
- Amorphous silicon: 13.4%
- Organic materials: 11.1%



There is no (real) manufacturer of organic solar cells today.



Simple fabrication: screenprinting



Application of org. solar cells

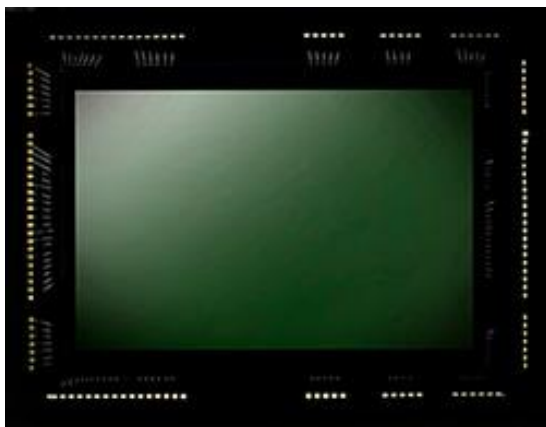


Photodetectors

Digital single-lens reflex camera Fuji X-PRO 1 (2012) and X-PRO 2 (2015)

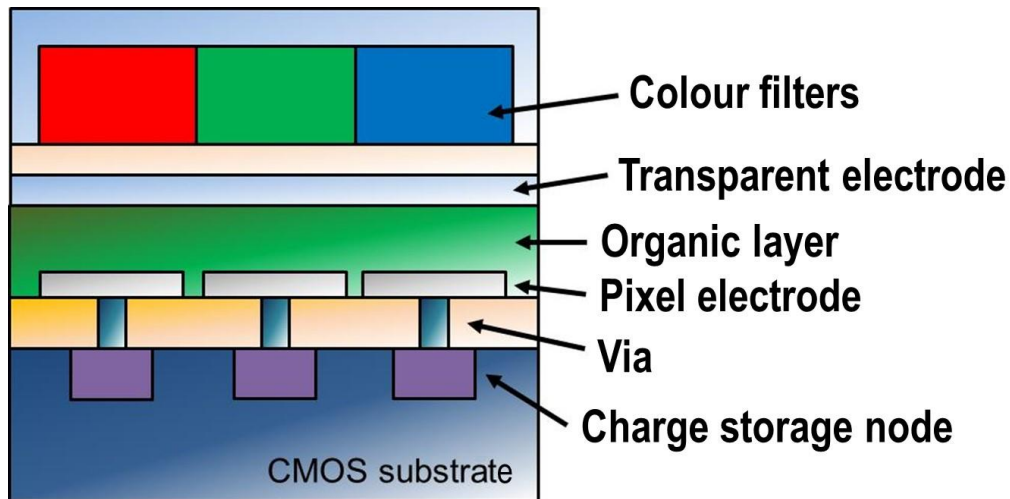
FUJI X-PRO 1

Une fiche technique audacieuse

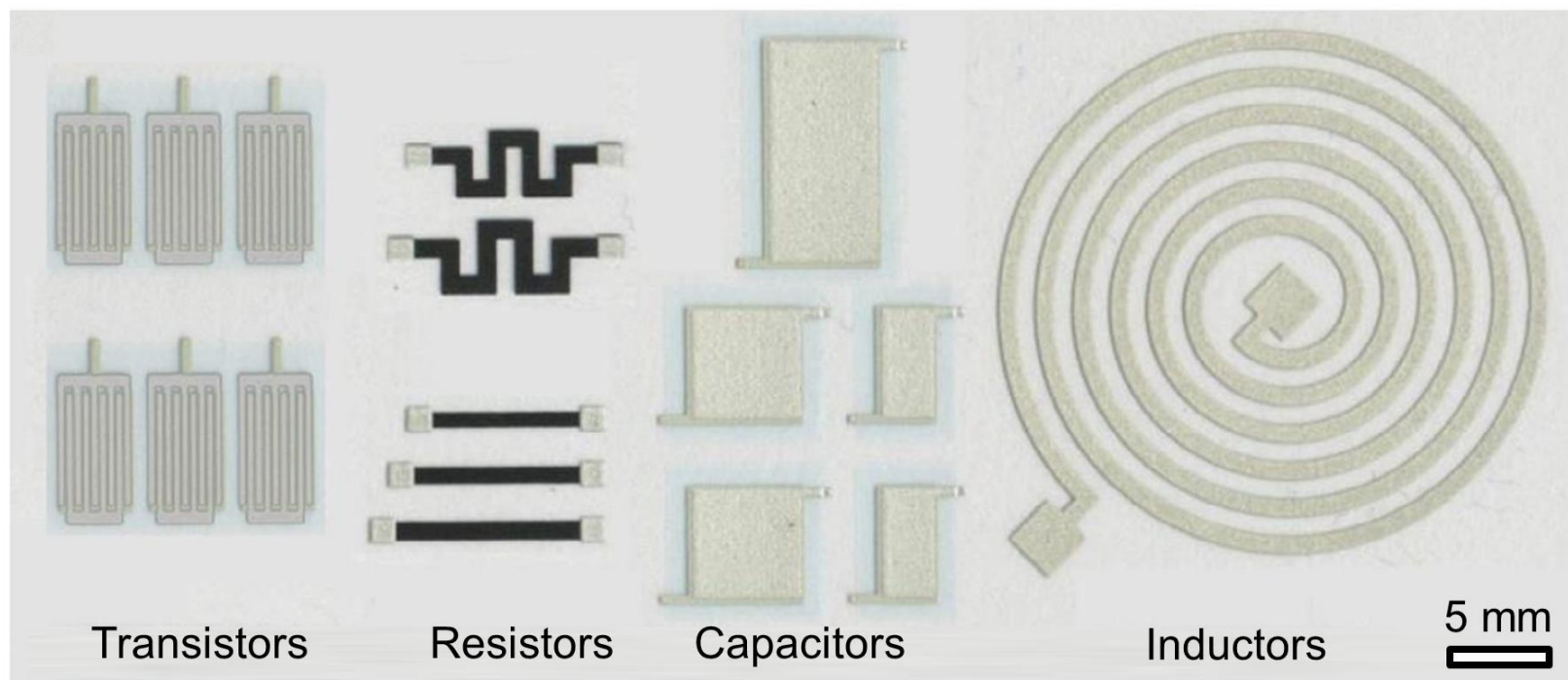
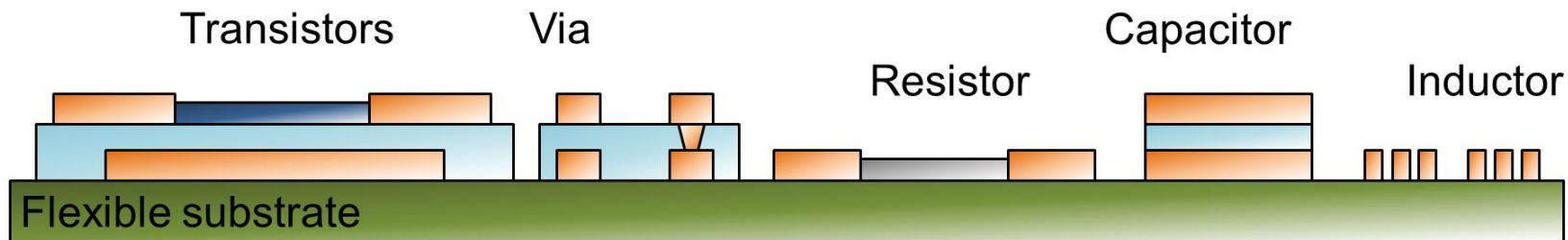


X-Trans CMOS

Hybrid CMOS chip with organic layer

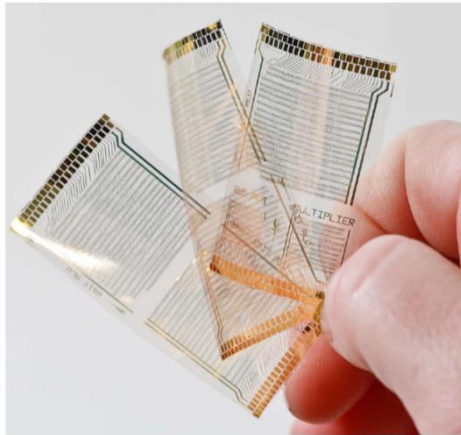


Patterning: printing technology



Memories, transistors, and logic circuits

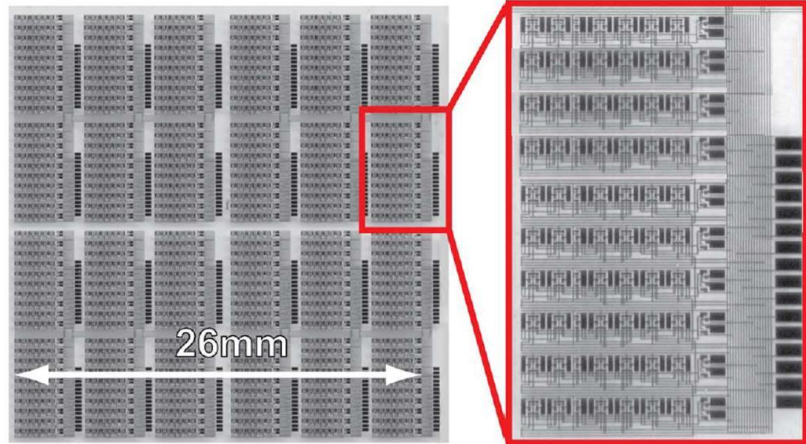
Possibility of integrated circuits based on organic electronics.
Expected to apply for OLED control and simple circuits (e.g. RFID).



organic 8-bit processor



Plastic logic, UK



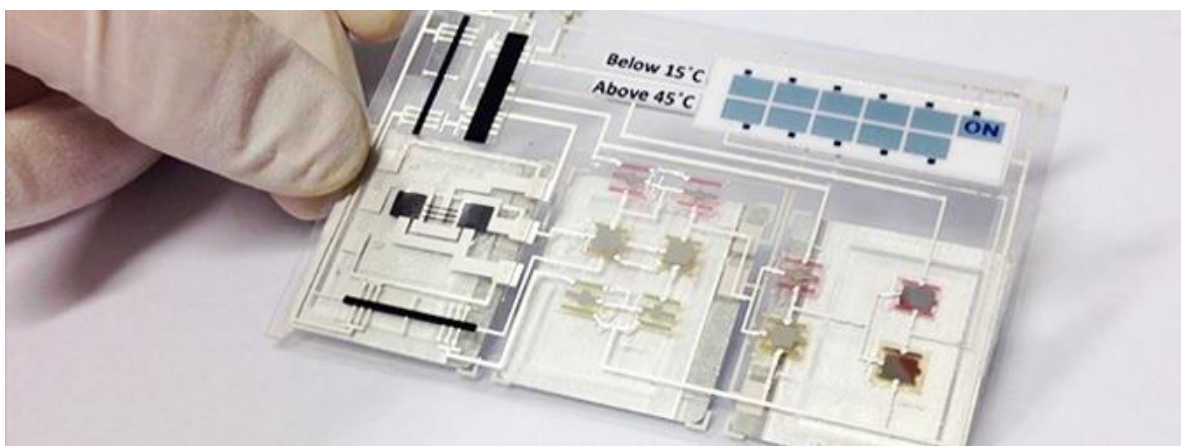
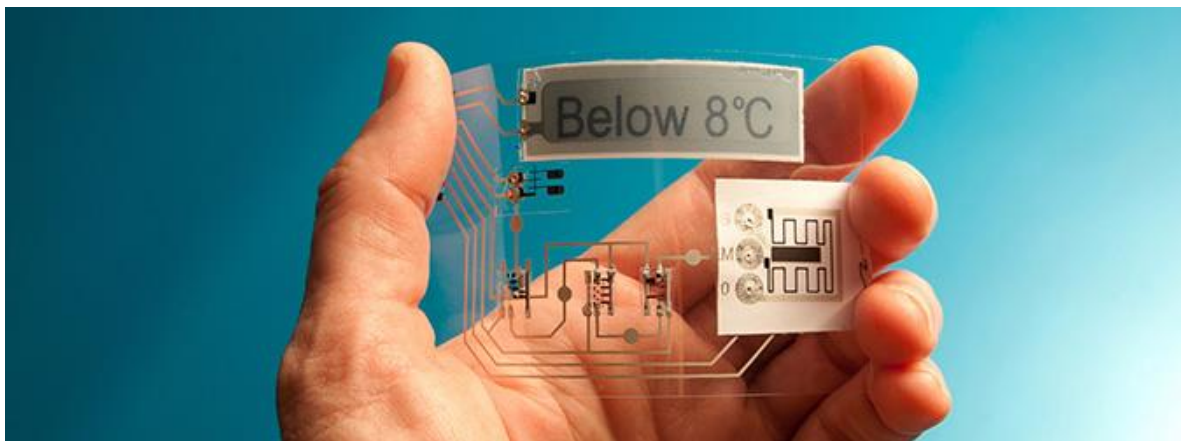
240-stage Shift Register

10-DFF Module



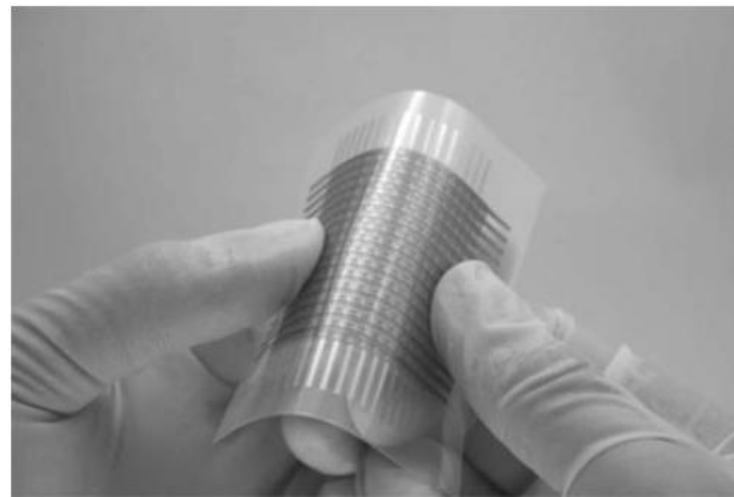
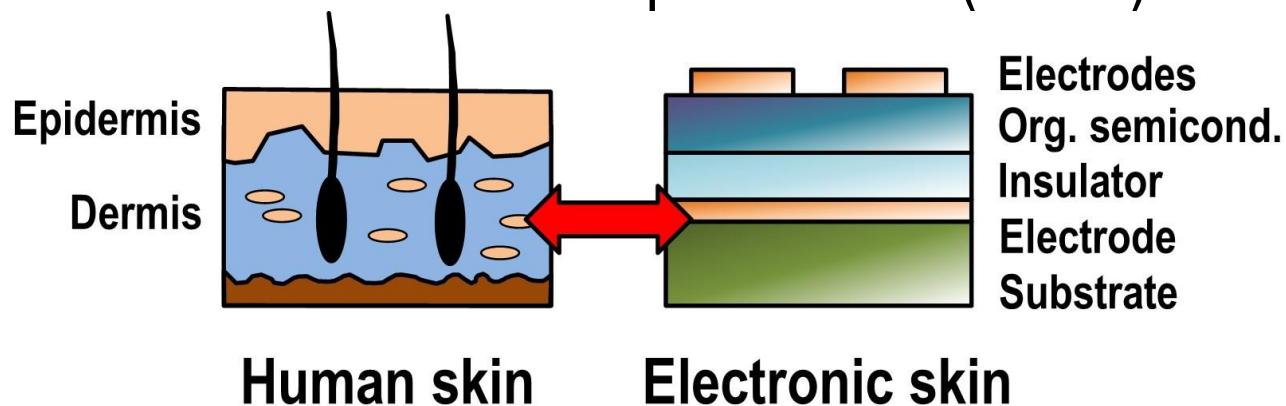
Applications of organic circuits

Various SMART sensors (mostly for IoT)



Nonstandard applications

Artificial electronic skin as haptic sensor (touch)



Opposite site to sensors: Actuators

- Piezoelectric materials based on organic molecules
- Some materials can shrink/stretch under external electric field.
- Possible to use as motors (artificial muscle)



Outlook to interesting future

- Try to imagine mix all together....

Energy harvesting
(organic solar cells and batteries)

Integrated circuits and memories
(organic transistors)

Motors / actuator
(piezoelectric)

Sensors
(of various kinds)



Next: Clean rooms lab-tour

