ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Non-Inavsive Glucose Device

Group 18

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What is diabetes ?

Diabetes mellitus :

Bad glucose uptake by cells

No insulin (type I)
No sensitivity to insulin (type II)

Consequence: Hyperglycaemia

Impact:

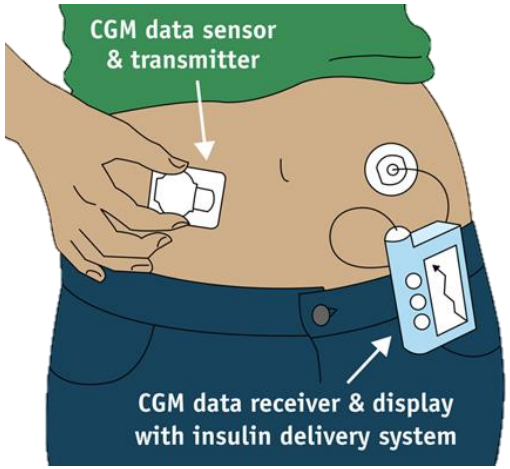
442.000.000 people in 2014

7th cause of death in 2030

Existing technology

Stripes

Continuous Glucose Monitoring (CGM)



→ All existing approaches are invasive

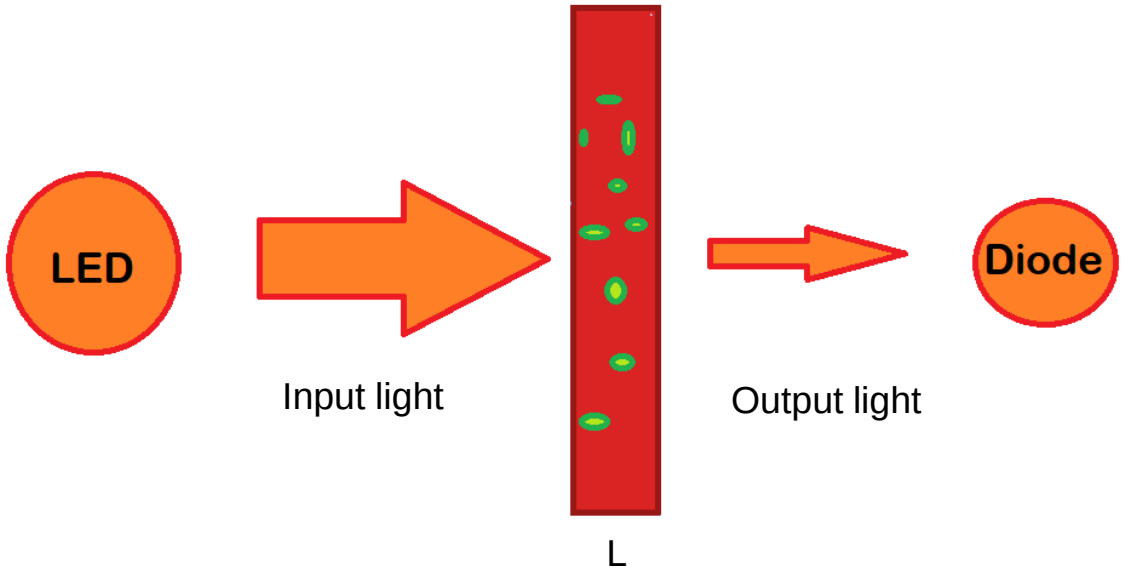
Our Solution

A non-invasive, wearable & discrete glucose monitoring device

Detection Principle: NIR

Absorption & Scattering

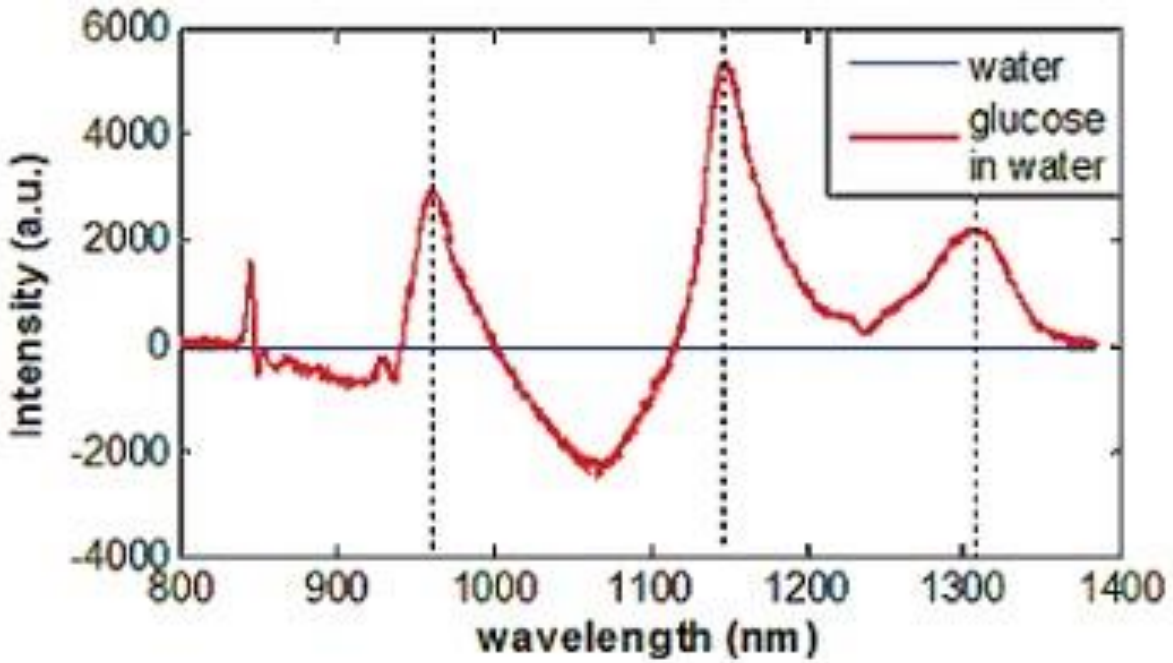
Wavelength & molecule dependent



$$I = I_0 exp(-\mu_{eff} L)$$

Detection Principle: NIR

Glucose absorption spectrum

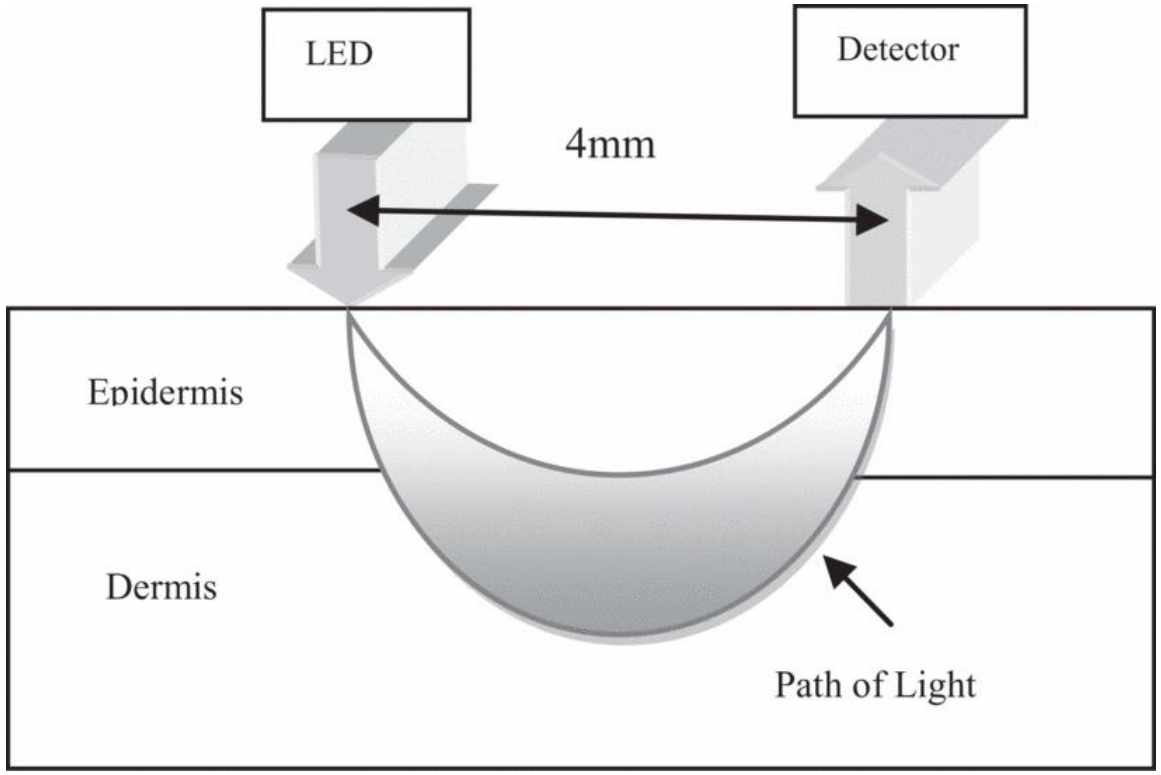


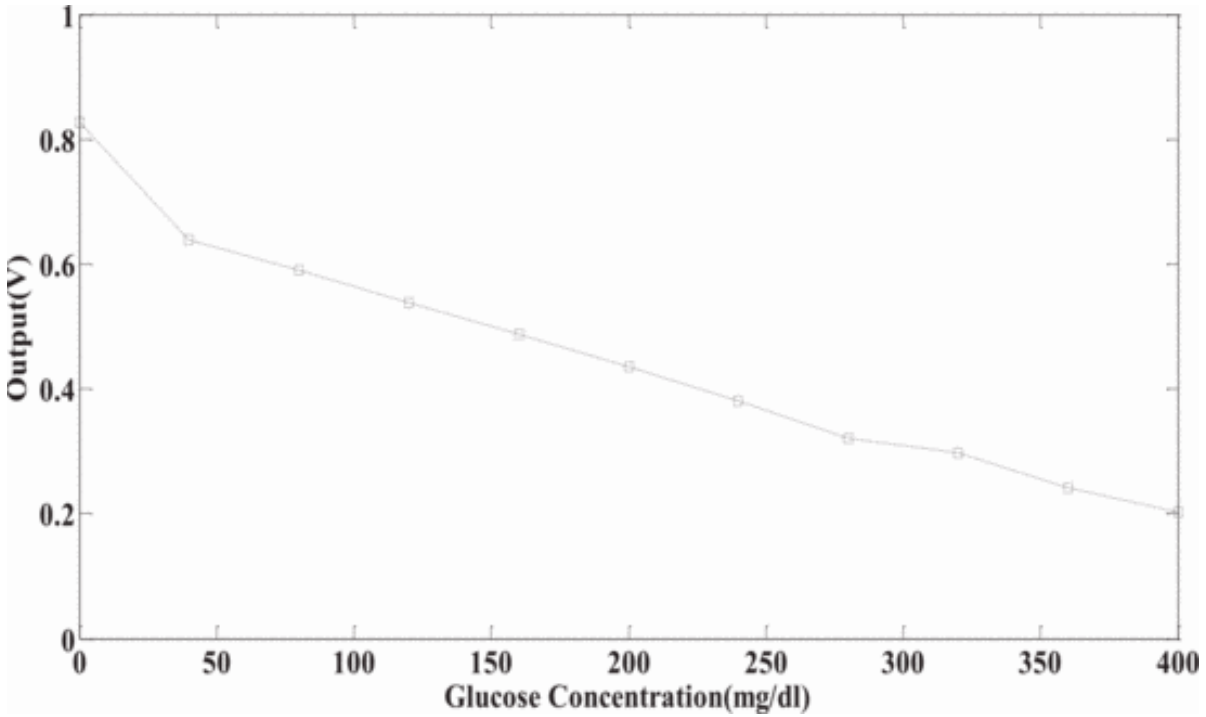
Used wavelength

940 nm

http://www.andor.com/learning-academy/spectral-response-of-glucose-spectral-response-within-optical-window-of-tissue

Detection Principle: NIR

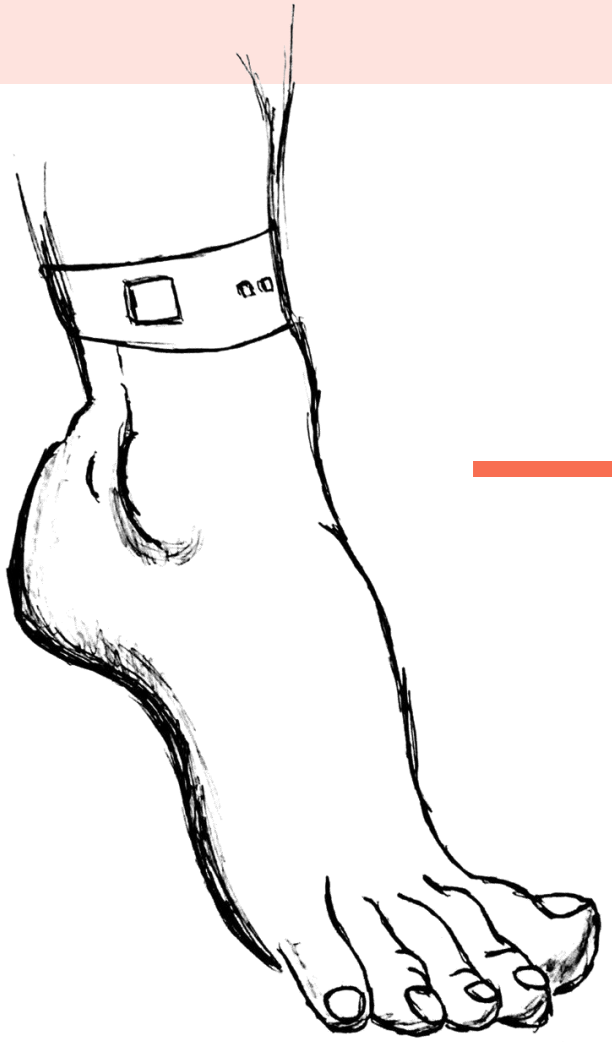




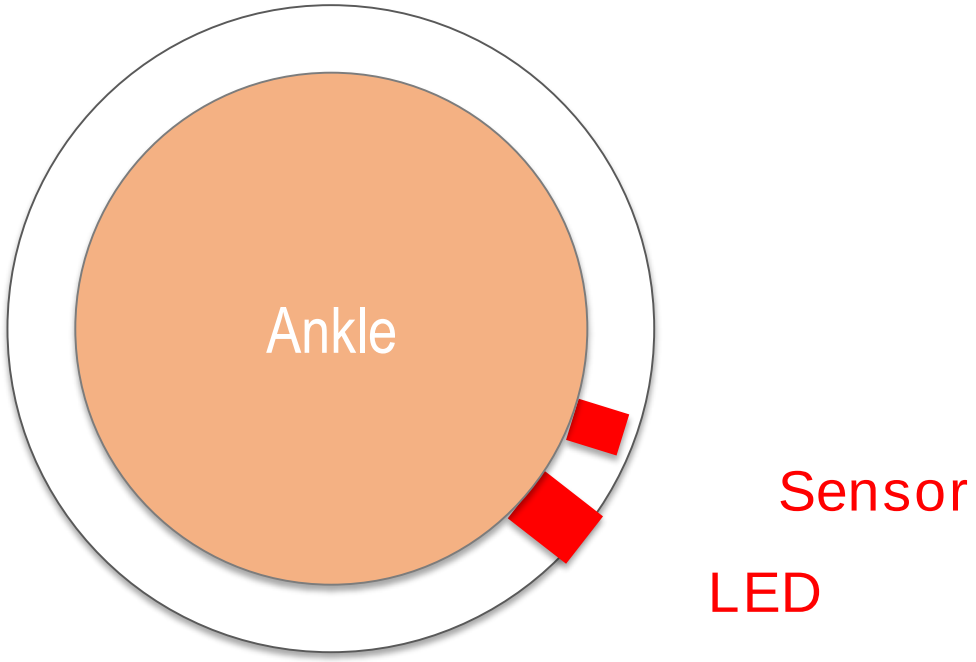
http://ieeexplore.ieee.org/xpls/icp.jsp?arnumber=6777023&tag=1#ref_4

Our Device

Our Device



Concept of our device



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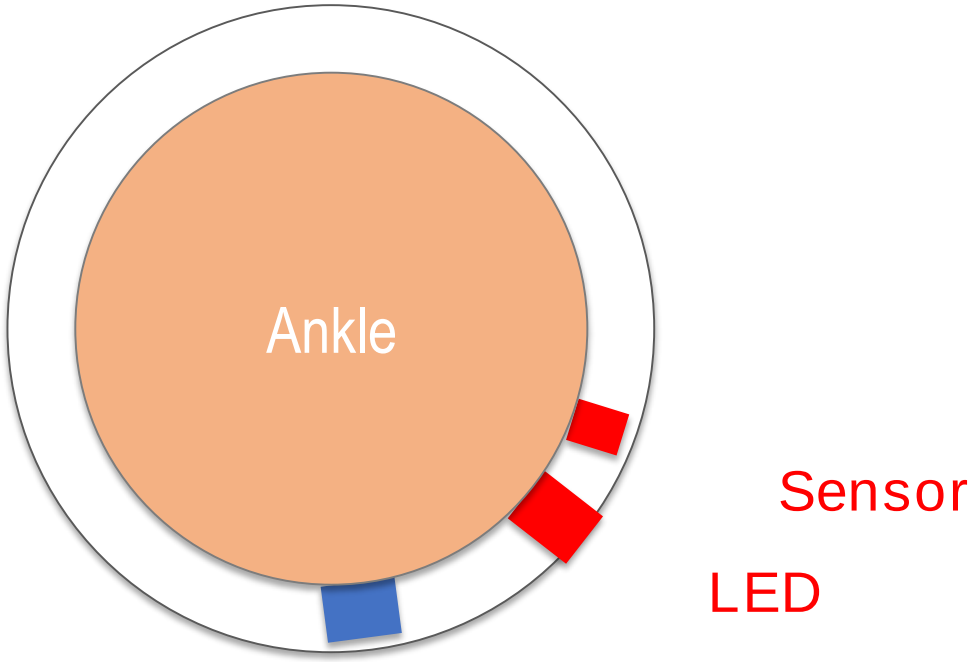

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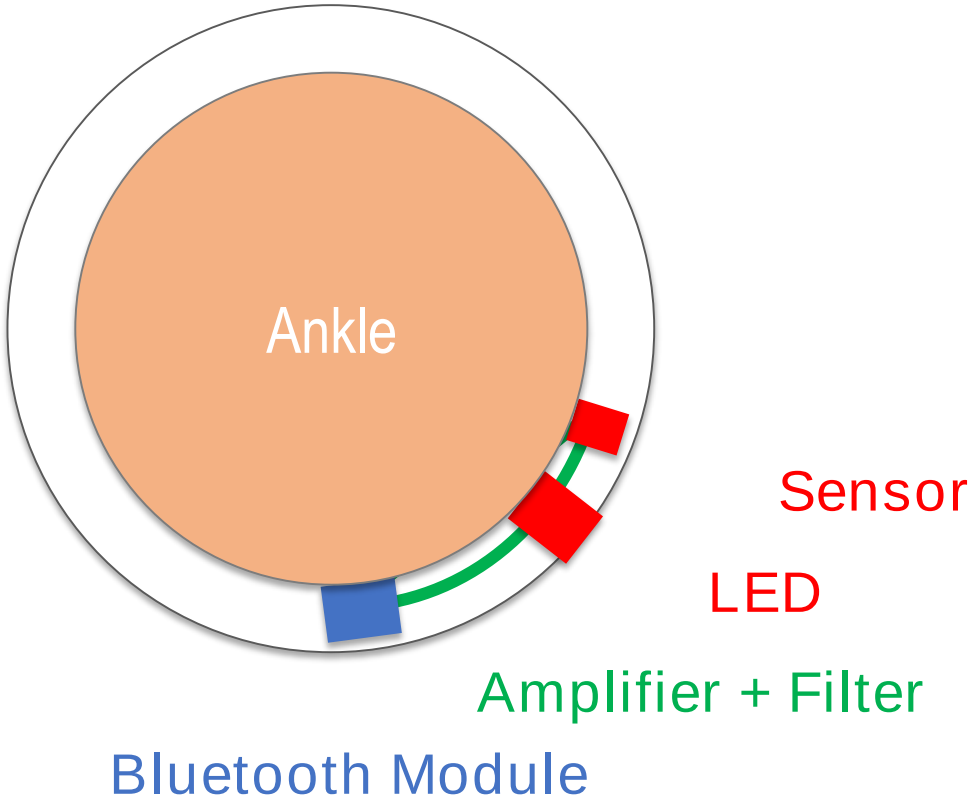
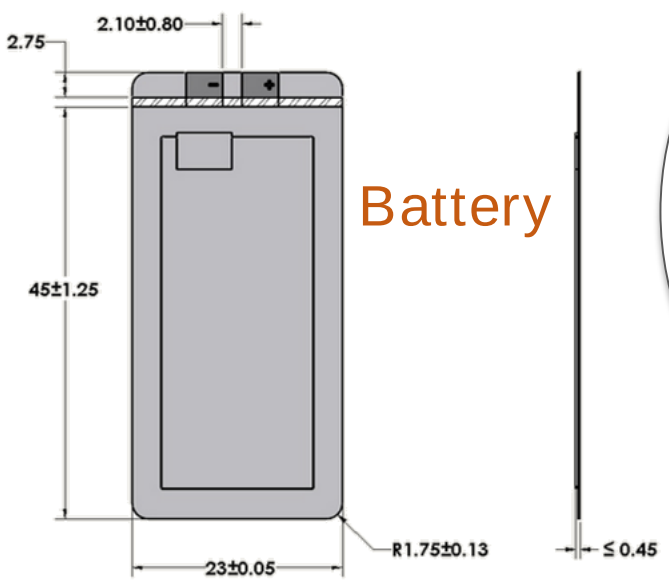
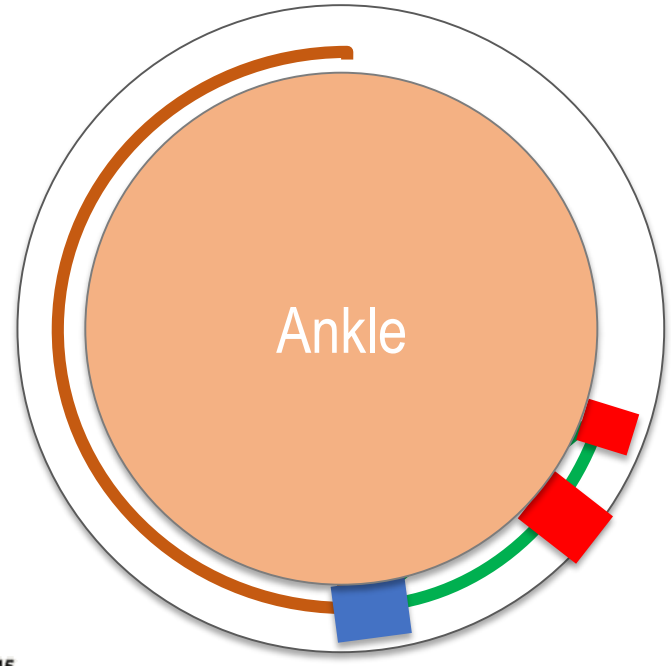


Concept of our device



Battery



9cm

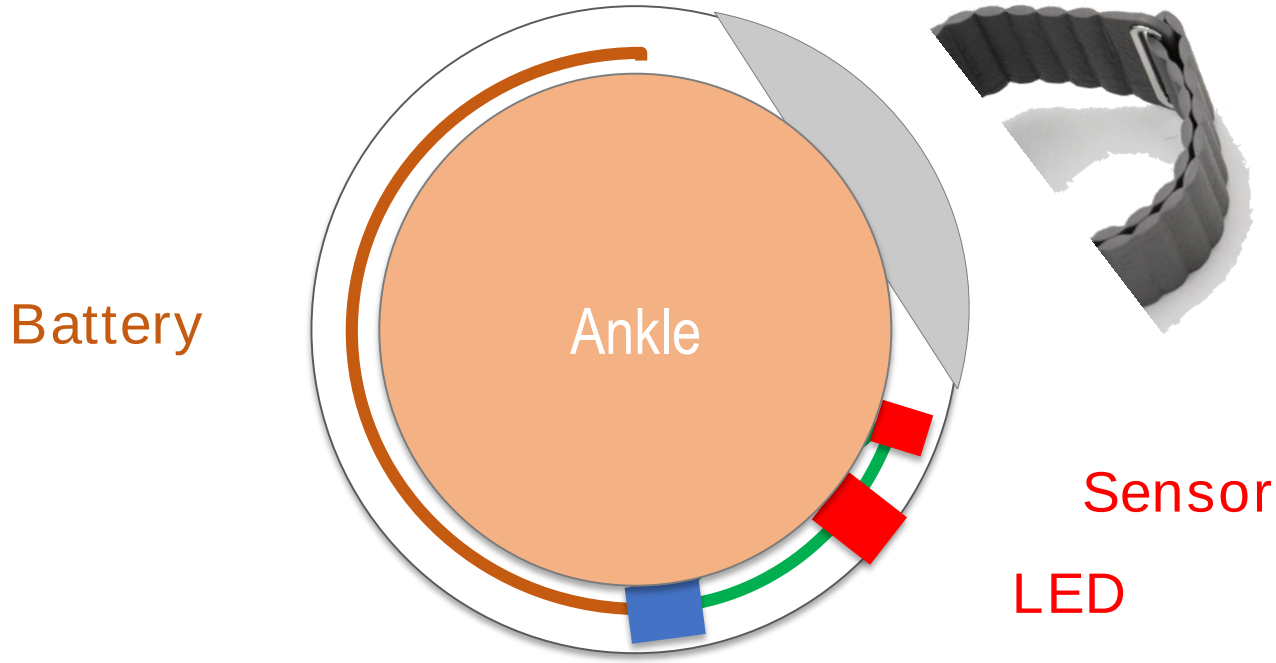
Sensor

LED

Amplifier + Filter

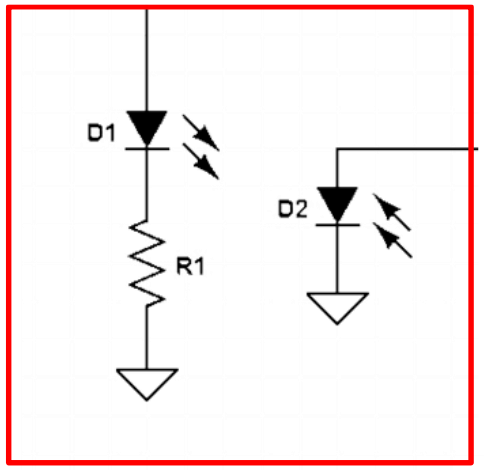
Bluetooth Module

Concept of our device

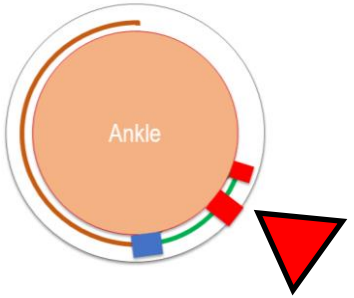


Magnetic Closing Mechanism

Circuit Concept



Measurement



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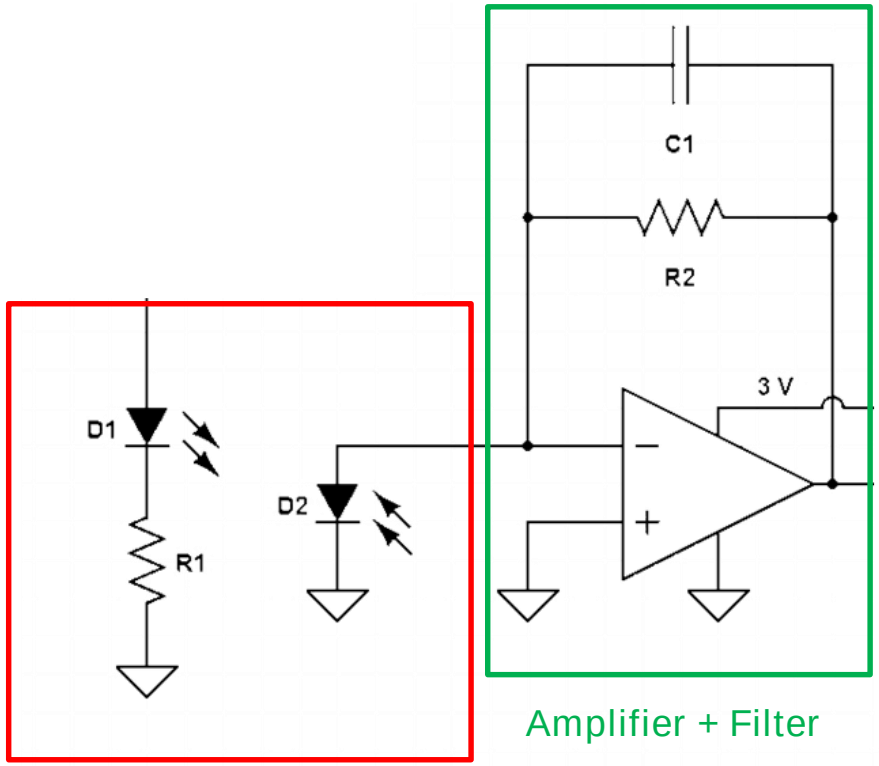
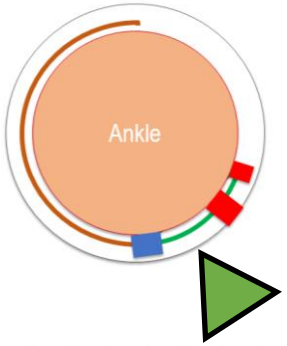
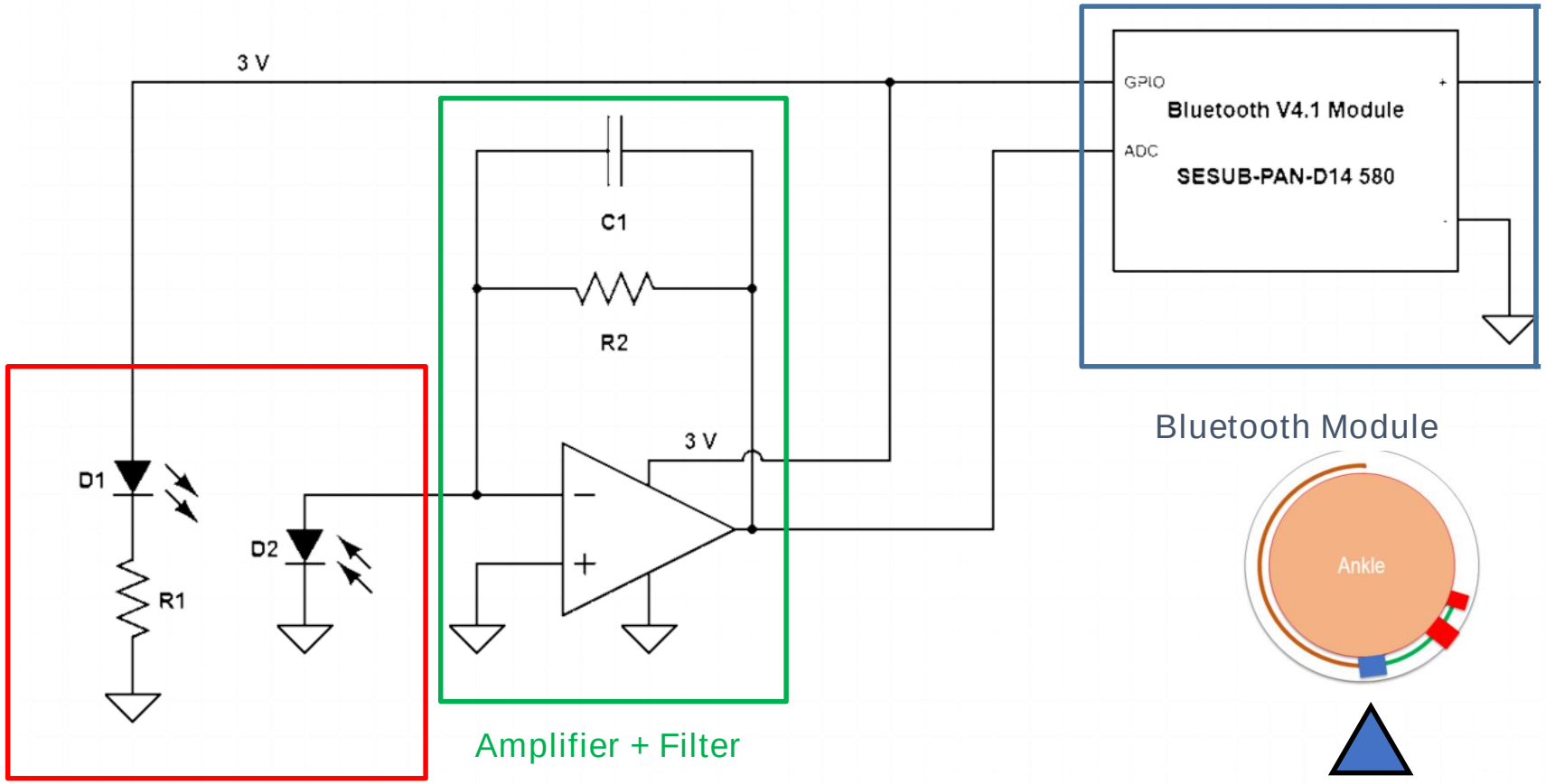


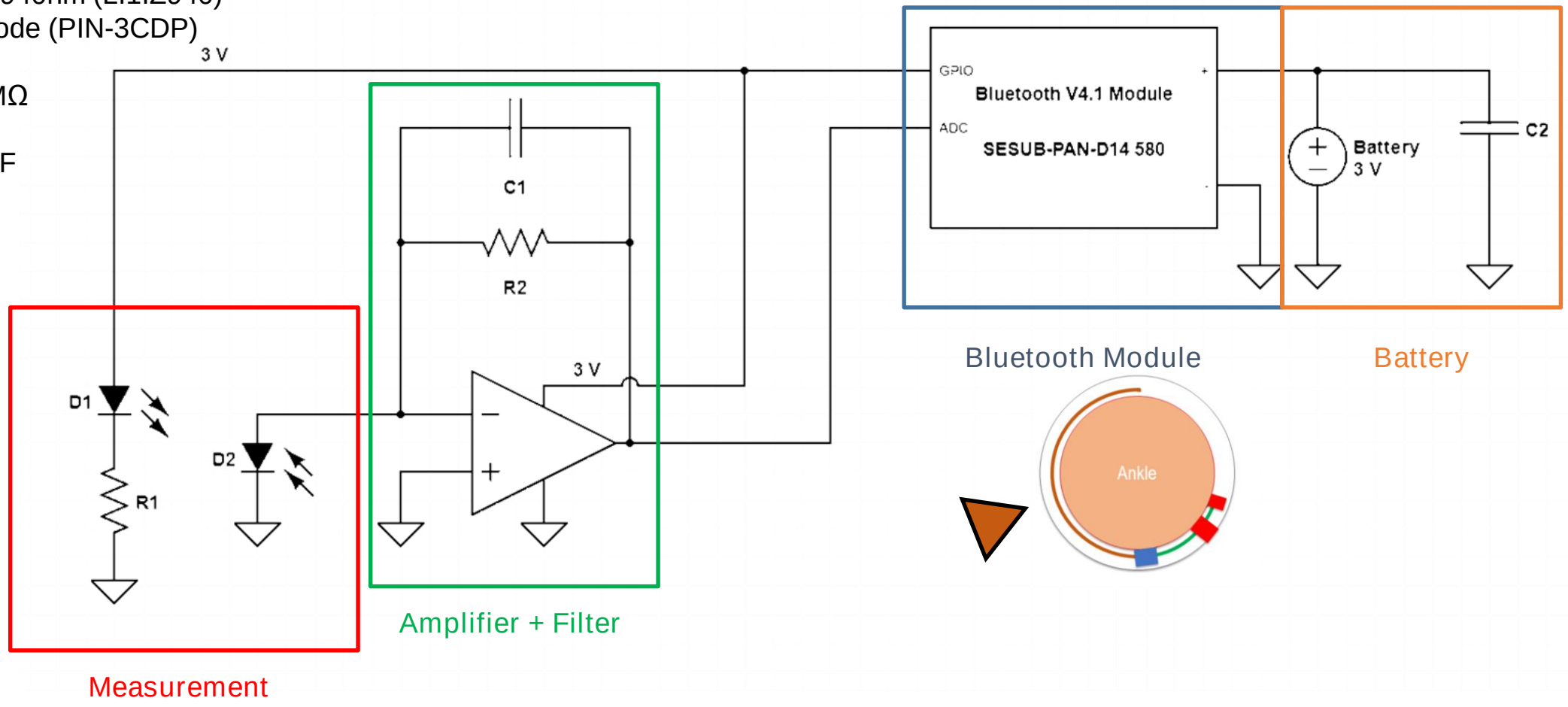


Circuit Concept



Circuit Concept

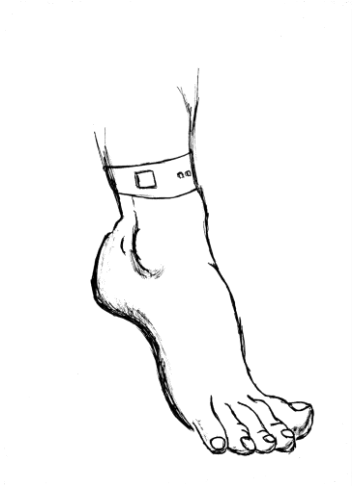
D1: LED - 940nm (LI1IZ940)
D2: PV-Diode (PIN-3CDP)
R1 = 1Ω
R2 = 500MΩ
C1 = 16pf
C2 = 100nF



Our Device

Pulse	500	ms
Pulse every	15	min
Usage per day	48	s
LED forward current	1000	mA
Bluetooth Peak Current	20.6	mA
Op-Amp	<1	mA
Total	< 1025	mA
Battery Capacity	48	mAh
Recharge after	60	days

Our Device



Benefits

Non-Invasive

Our Device

Benefits
Non-Invasive
Convenient

Our Device

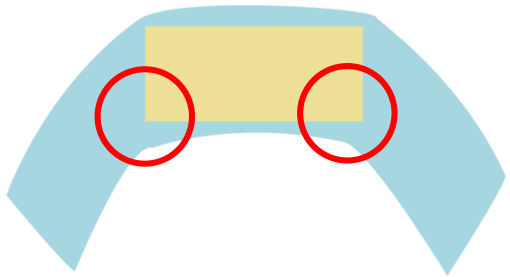
Benefits
Non-Invasive
Convenient
Discrete

Manufacturing - Flexiblity

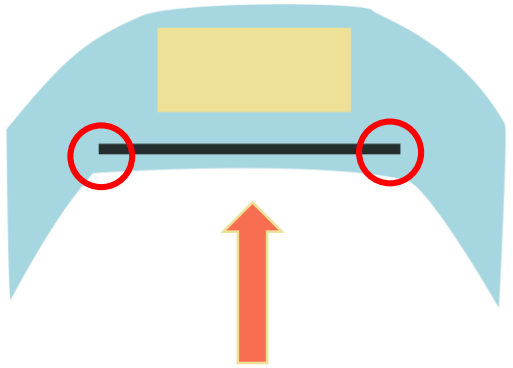
LED

Thickness : **700 µm**

BENDING



Interconnections



WITH RIGID ISLAND UNDERNEATH

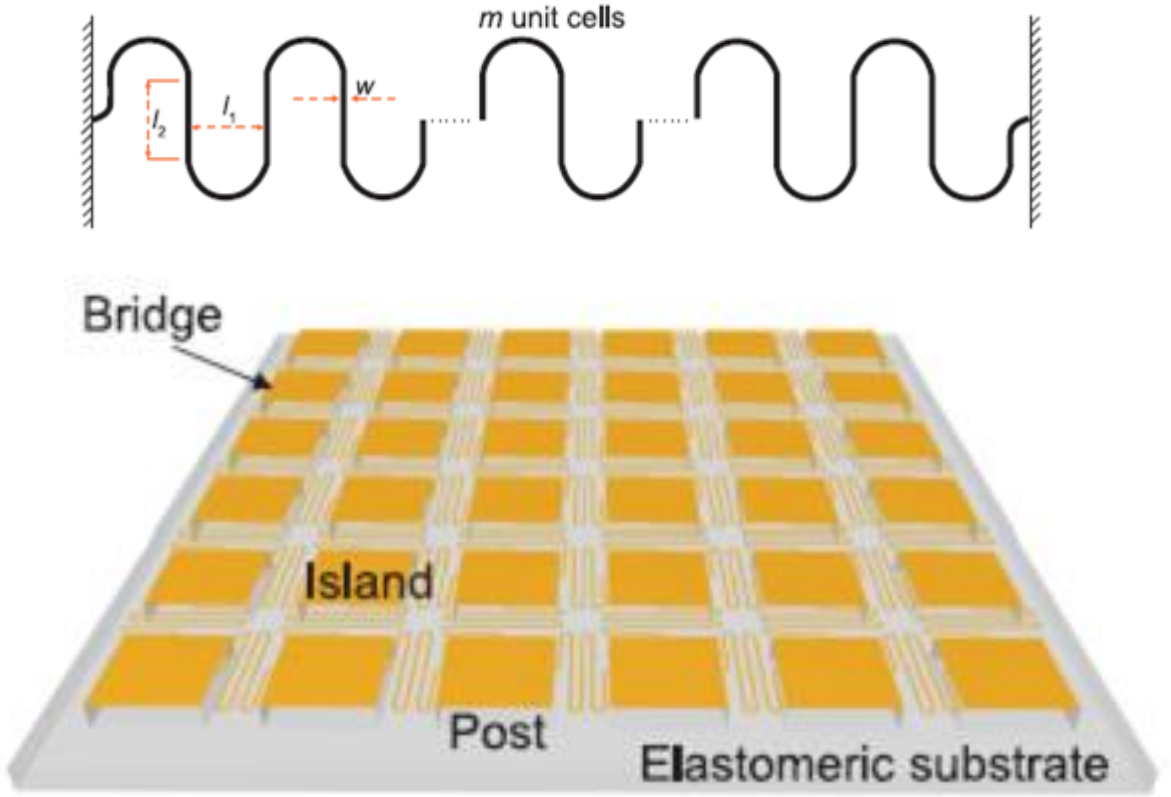
ISLANDS : Relieve stress onto existing rigid components

Manufacturing - Stretchability

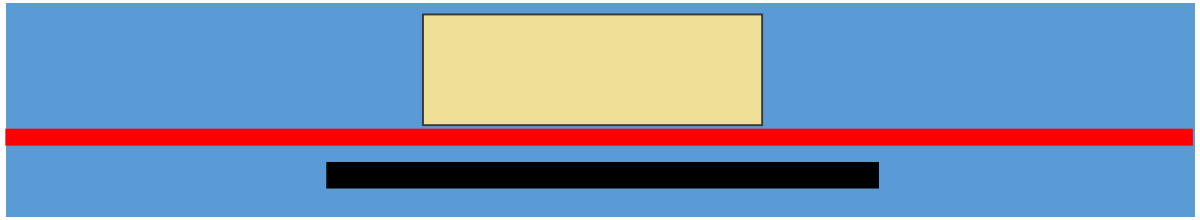
Bridge-Island Technique:

1. Adding a rigid island under LED
2. Keeping serpentine bridge

Expands the stretchability even further



Manufacturing - Materials



Substrate:
PDMS

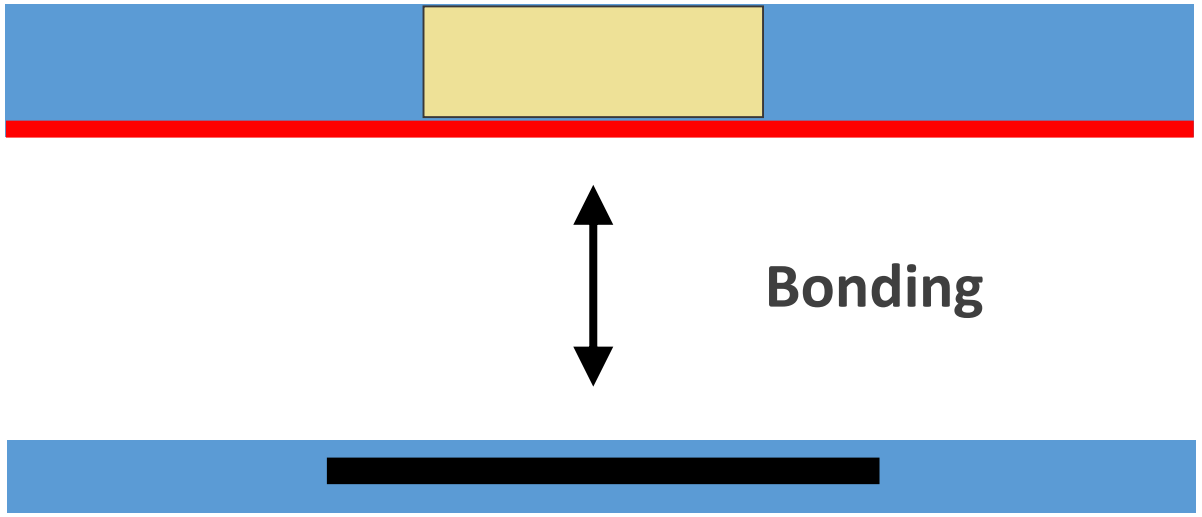
Rigid Island:
Raisin Epoxy

Thin metal layer for interconnection:
Platinum or gold

Encapsulation:
PDMS

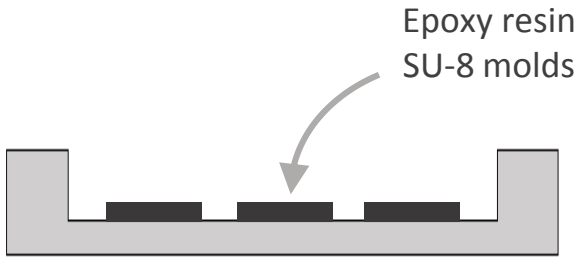
Manufacturing – Process flow

Manufacturing of
2 parts

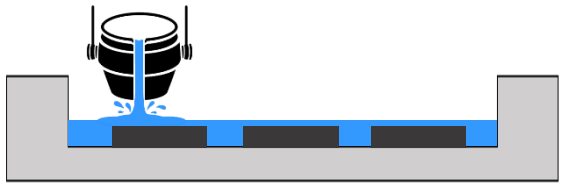


Manufacturing – Process flow

First Part

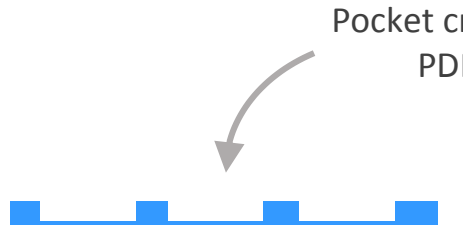


1. Create the matrix

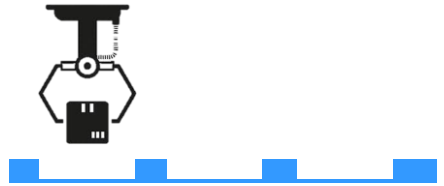


2. Cast PDMS on matrix

3. Bake PDMS
4h | 75° C



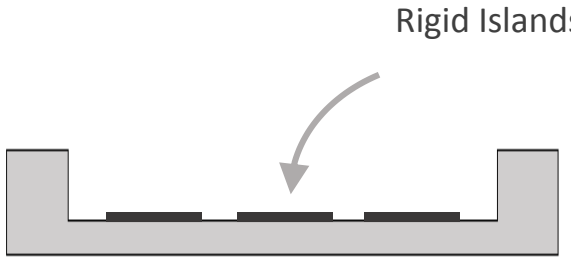
4. Flip the PDMS over



5. Pick and Place rigid components

Manufacturing – Process flow

Second Part

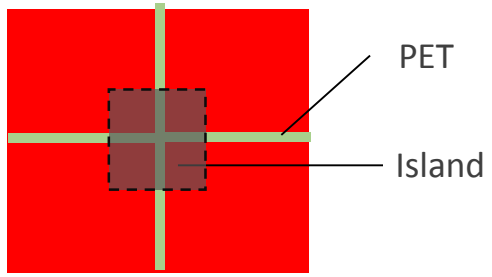


1. Place islands

2. Cast PDMS on islands

3. Flip the PDMS over

4. Cast Gold/Platinum on layers



5. Shadow Mask Gold

Thank you