

Millimeter-Scale Smart Sensing Semiconductor Devices for Biomedical Applications

Inhee Lee

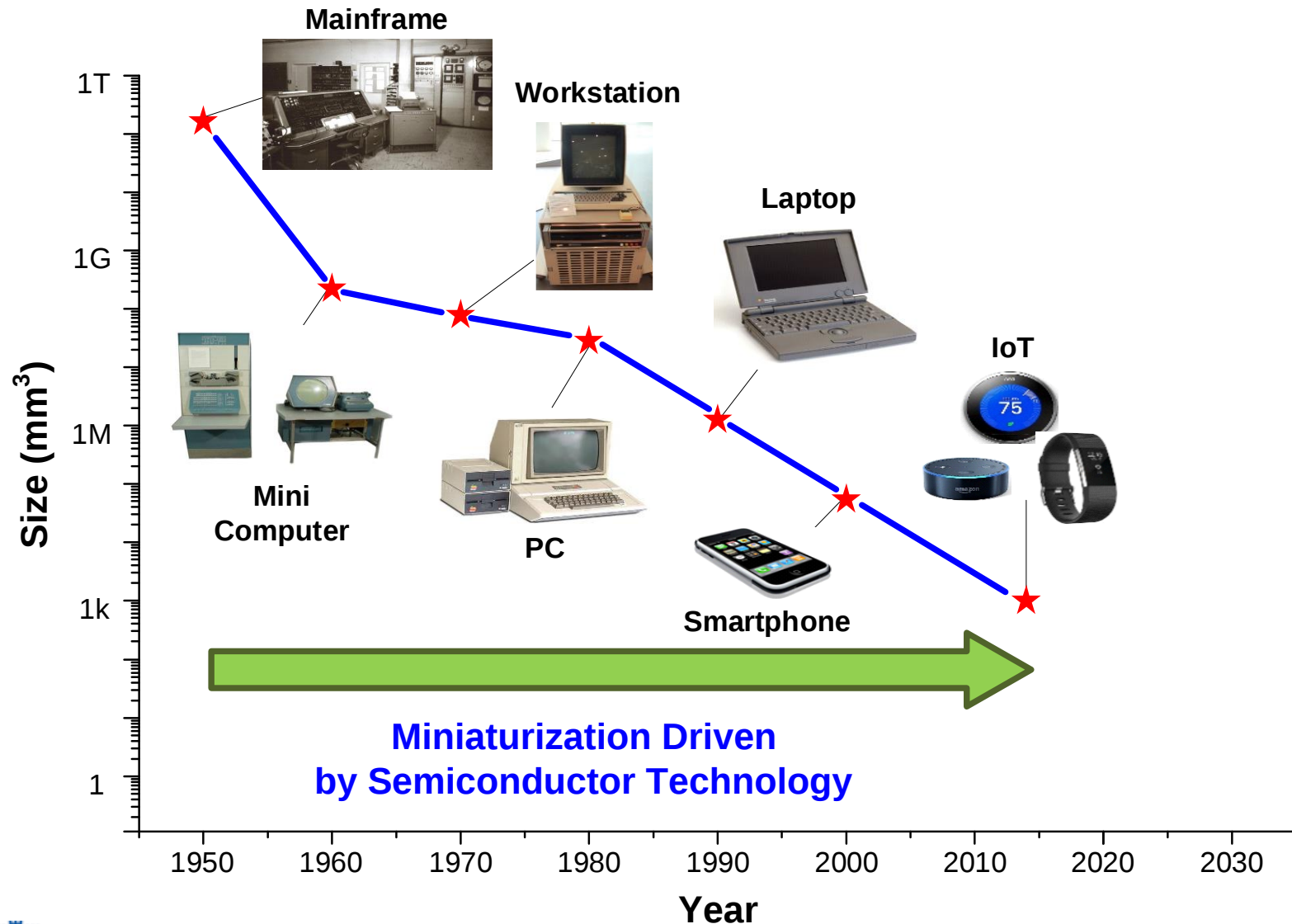
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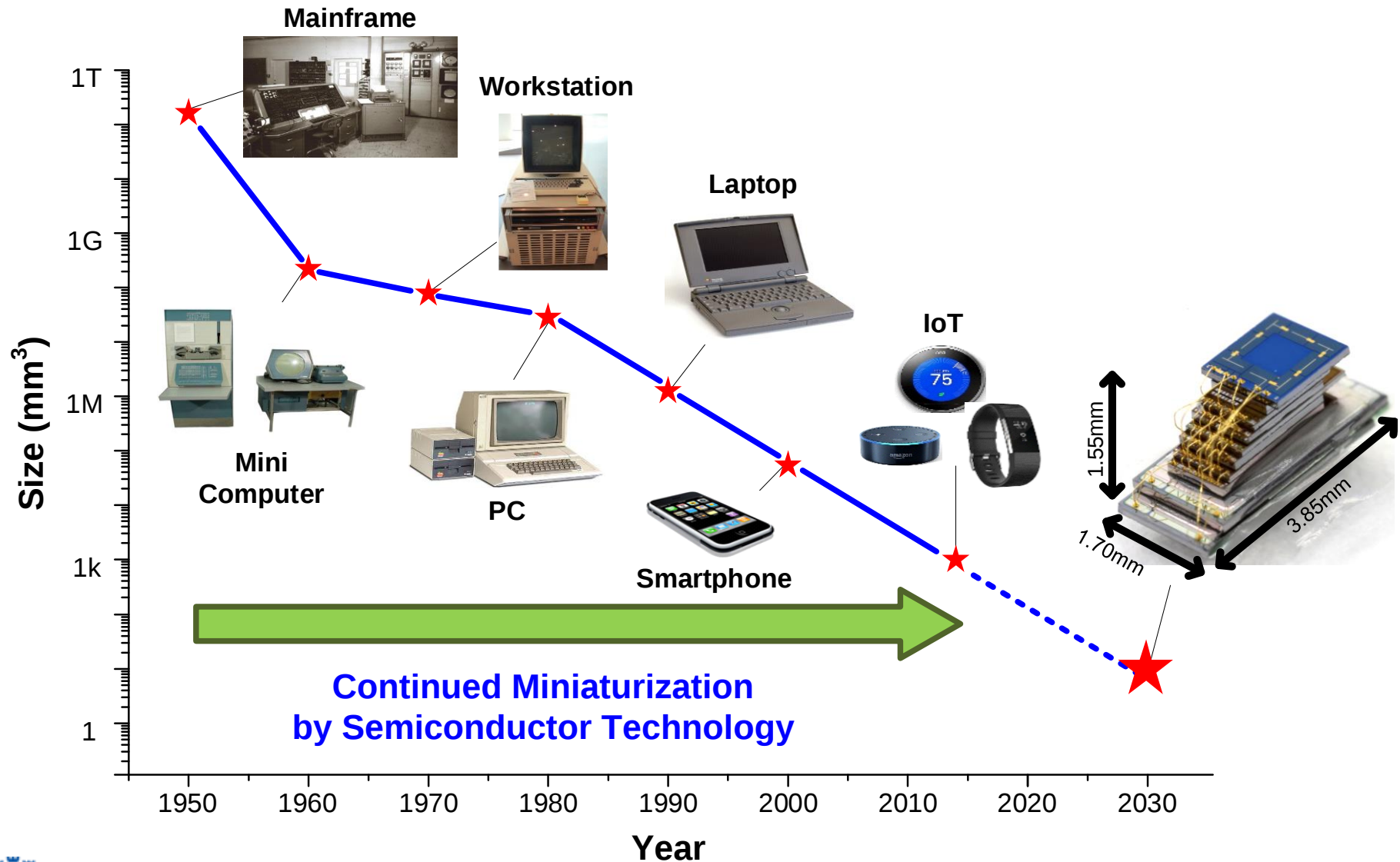
9/23/2024



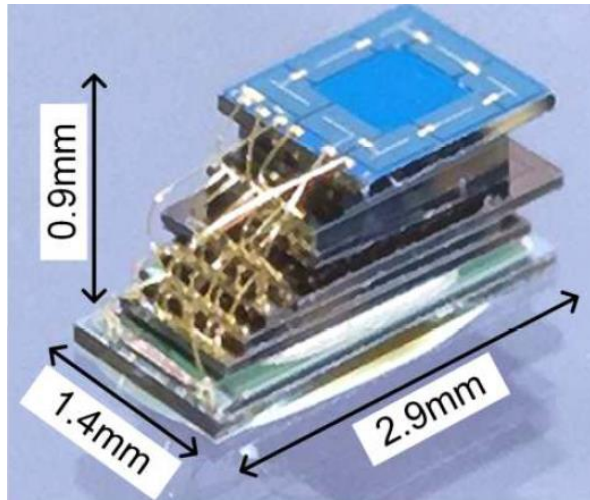
Past Sensing & Computing Systems



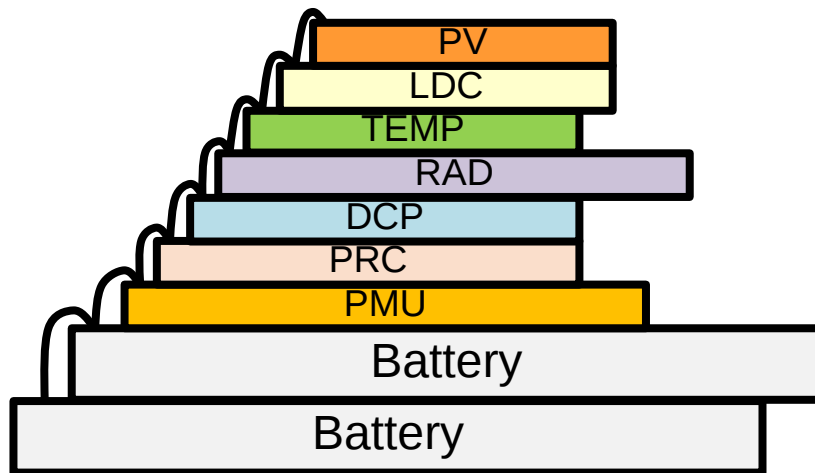
Millimeter-Scale Sensing System



Die-Stacked System Platform



[Li, ESSCIRC '21]



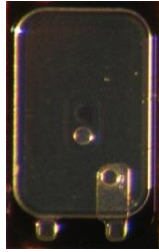
- Proposed in ISSCC 2012
- Modular die-stacked structure
- Maximize circuit design area per volume
- Enables diverse technology
- Swappable layers

- ~10 μ A active mode (< 100ms)
- ~10nA sleep mode (> 1min.)
→ Only turn on low-power power management unit, optical receiver, wakeup timer, SRAM

Available Power Budget



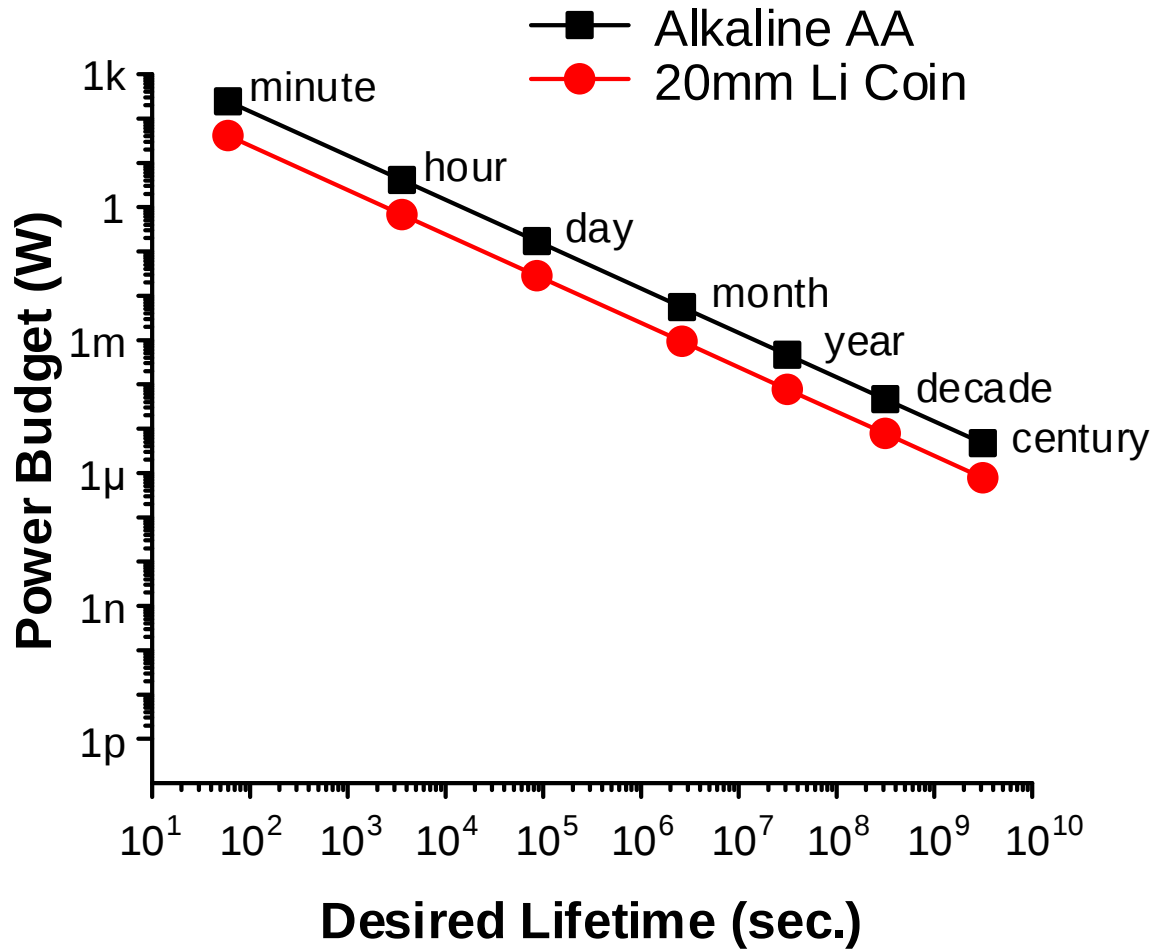
Alkaline AA
(9800mm³)



1mm² Li Thin-film
(0.2mm³)



20mm Li Coin
(1280mm³)



Available Power Budget

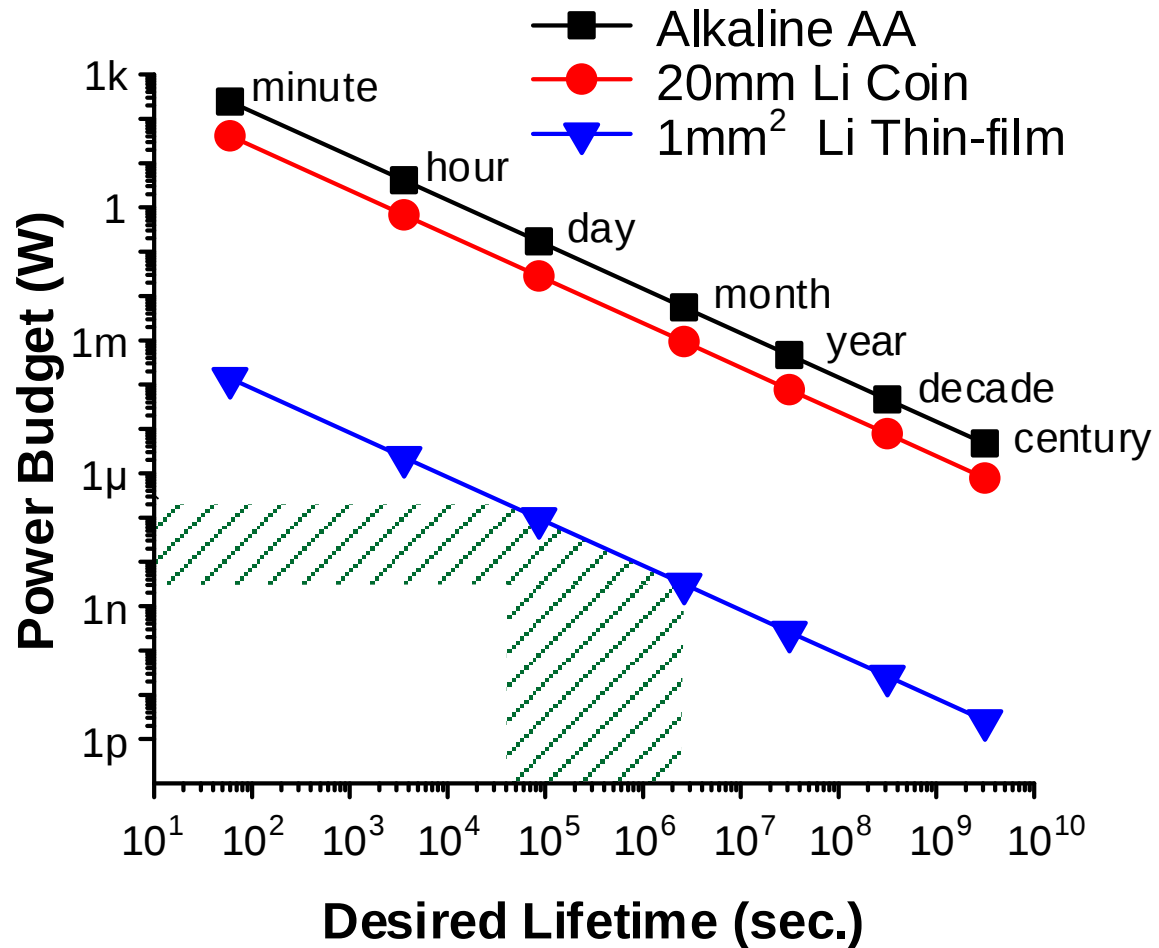


Alkaline AA
(9800mm³)

1mm² Li Thin-film
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20mm Li Coin
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Computer History Museum



The World's Smallest Computer

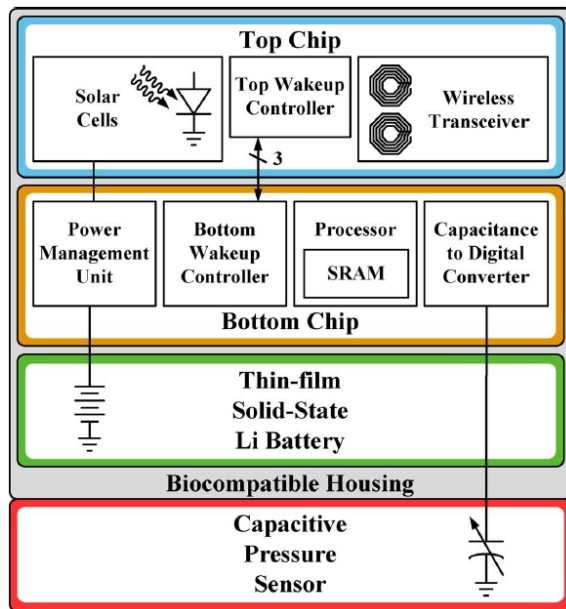
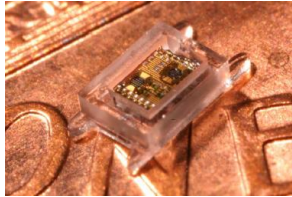
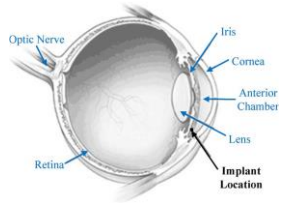
 Dag Spicer  March 26, 2015  Curatorial
1 Comment

A new exhibit at CHM takes a look at the world's "Micro Mote." Making things smaller has been part of the field's beginnings. Smaller tends to make things more efficient. Recently, researcher Gordon Bell observed that as computer devices (and their components) get smaller, they follow a regular pattern and prompts new discoveries (and new devices) of computer device at more or less regular intervals.

<http://www.computerhistory.org/atcm/the-worlds-smallest-computer/>

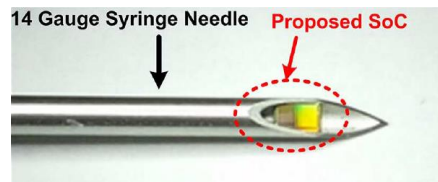
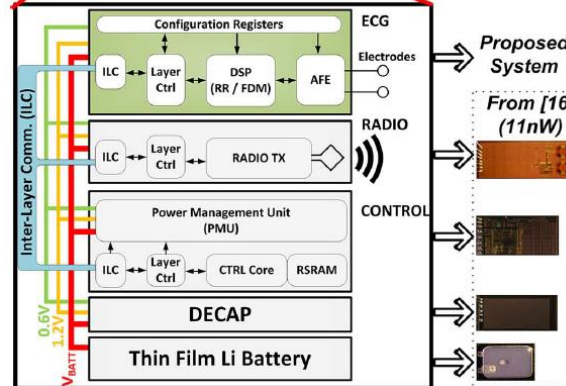
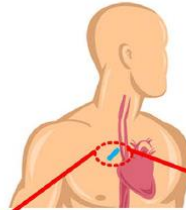
Biomedical Applications

IOP



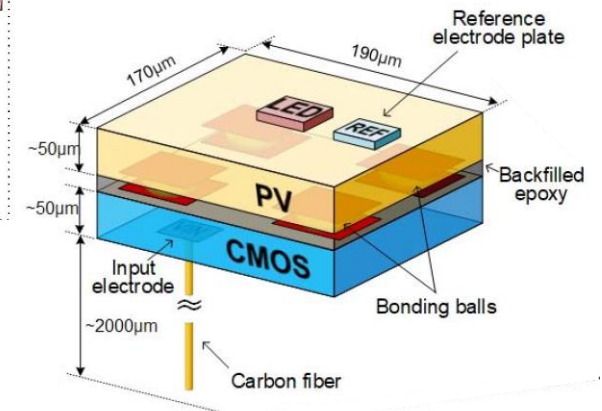
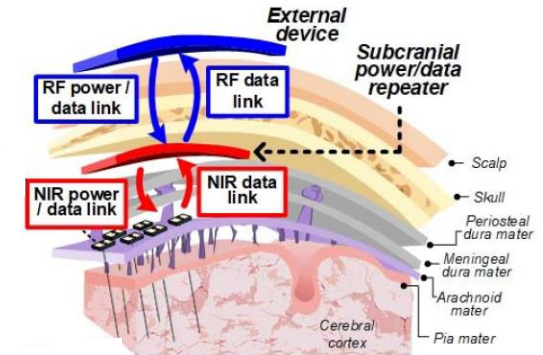
[Li, TCAS-I '13]

ECG



[Chen ISSCC '15]

Neural Recording



[Lim ISSCC '20]