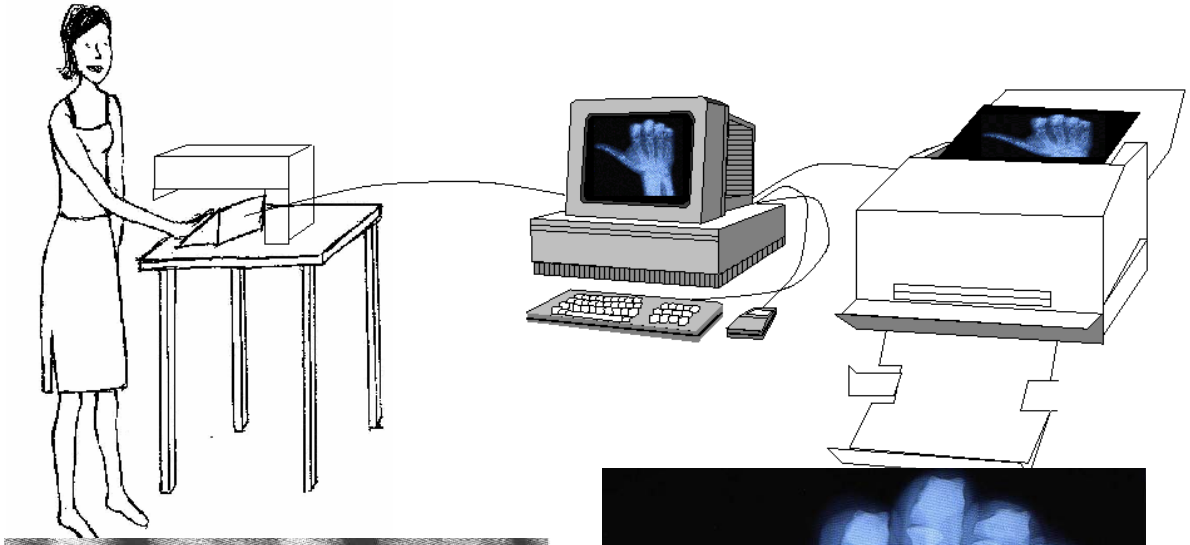
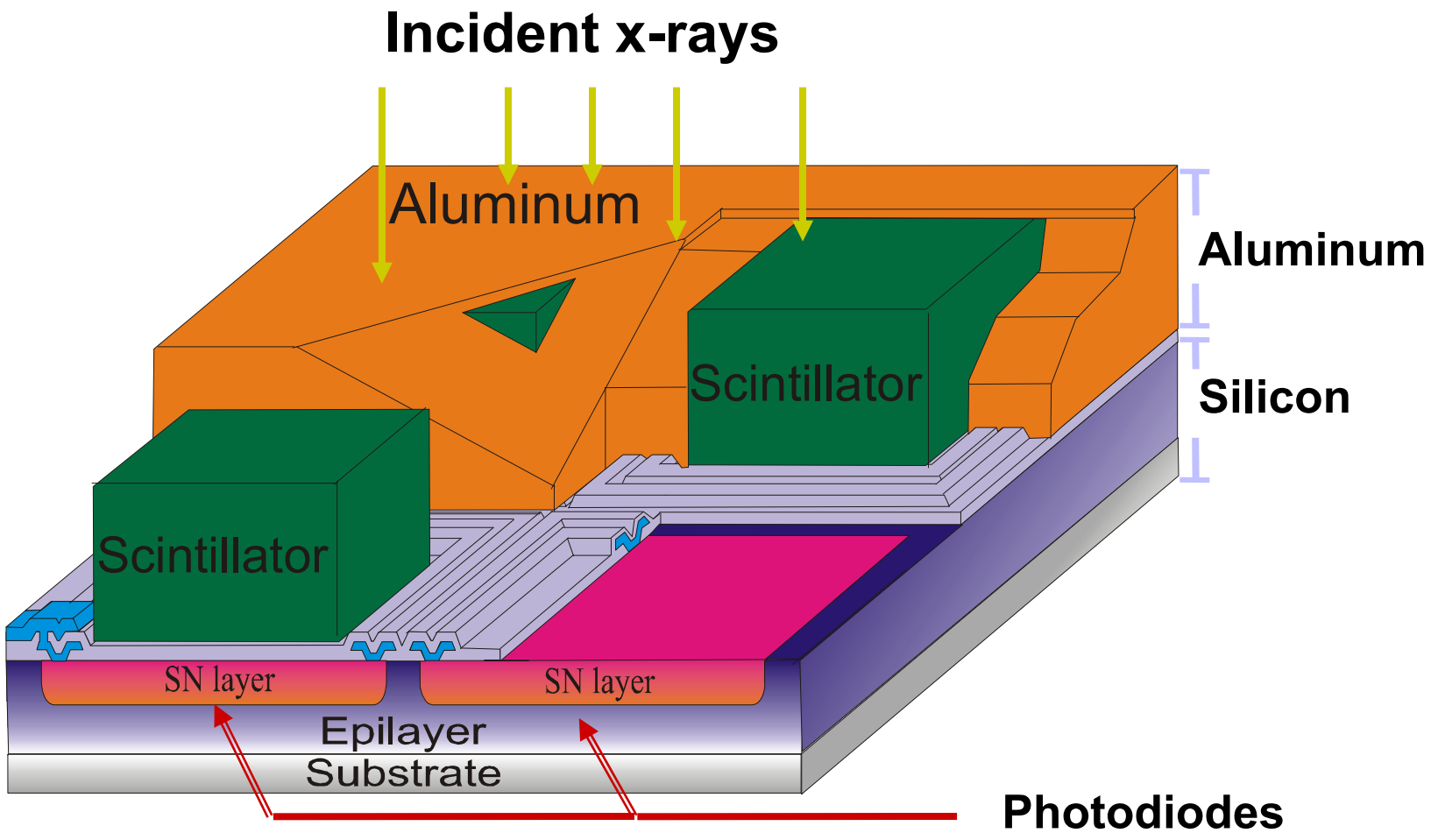
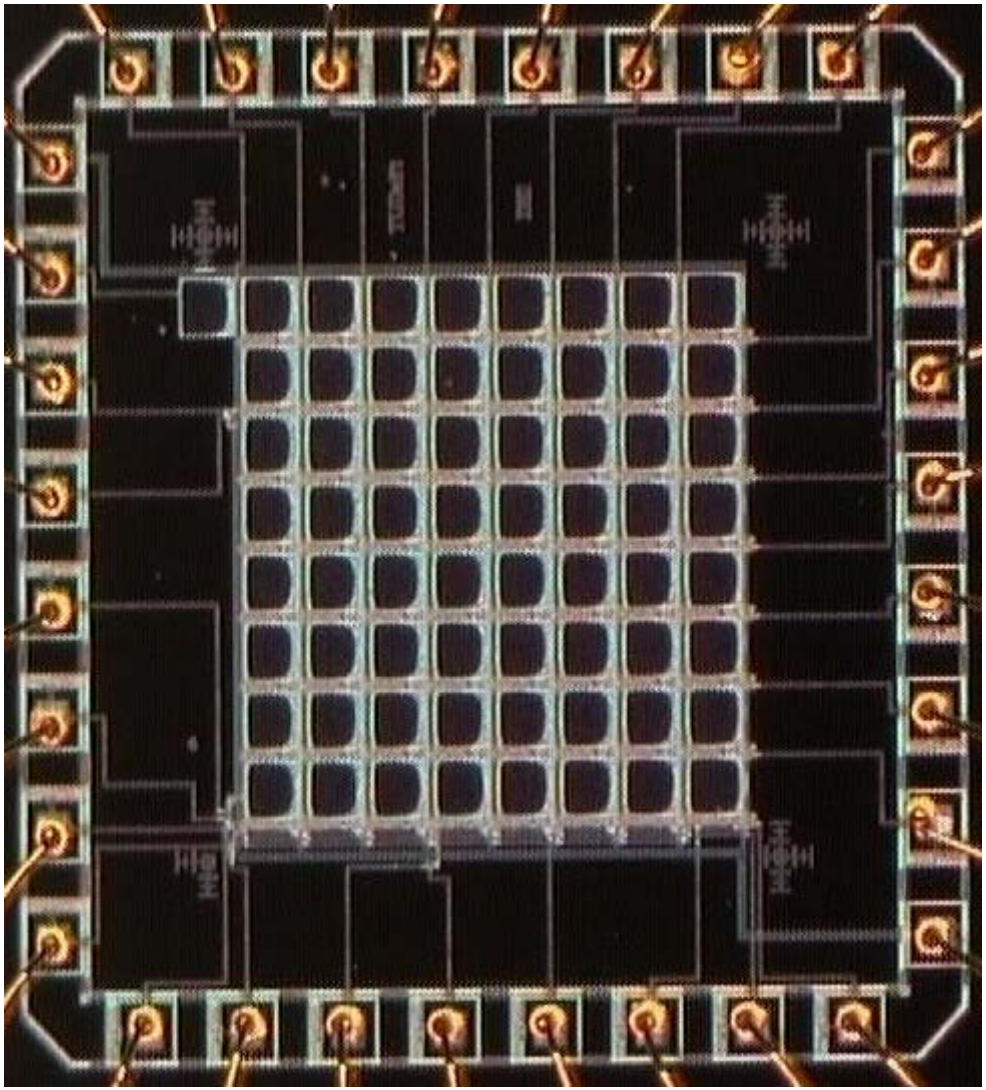
X-rays digital radiography in CMOS Tech (FCT)



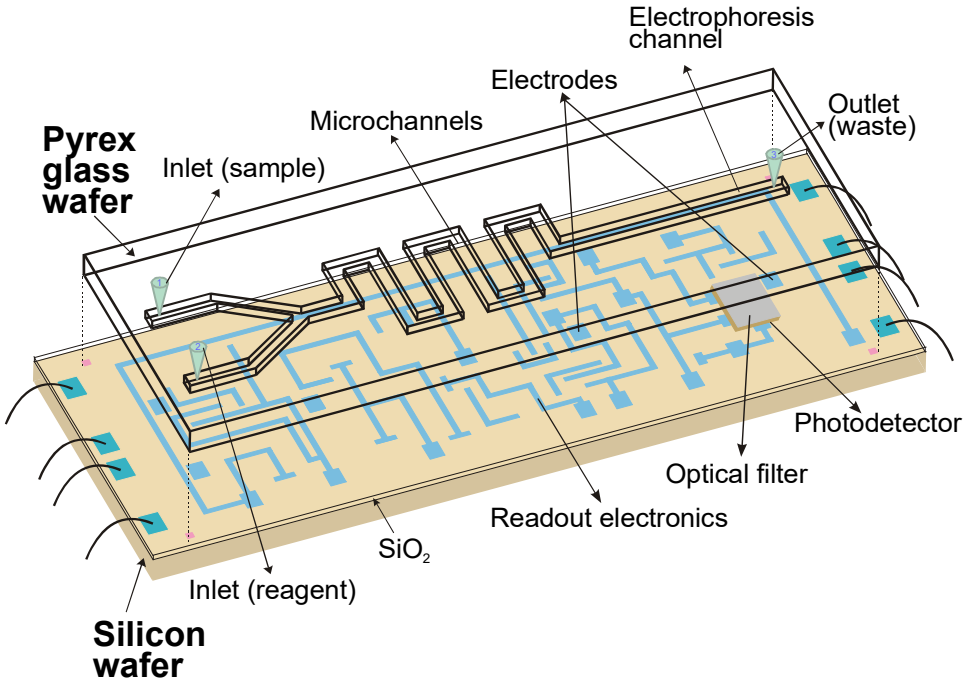
X-ray chip structure in CMOS technology

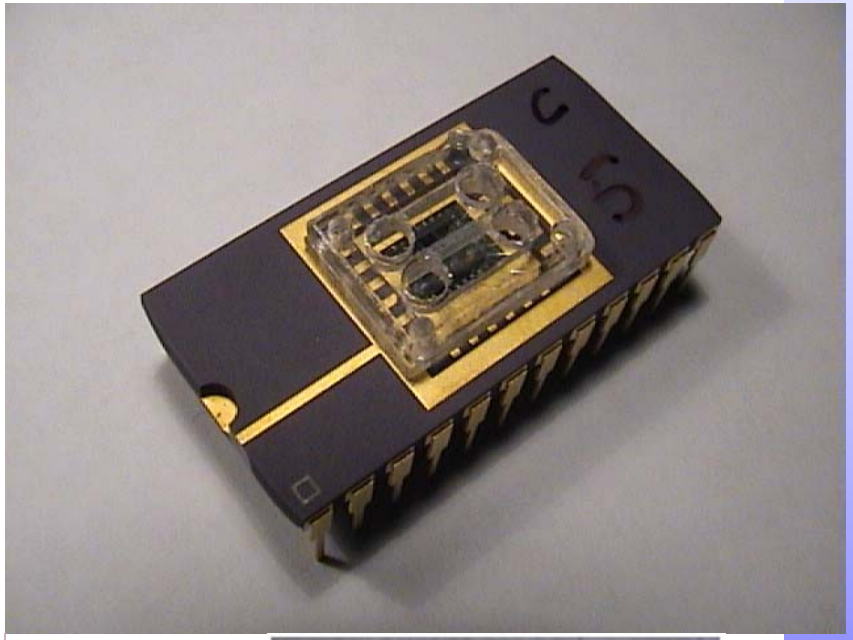


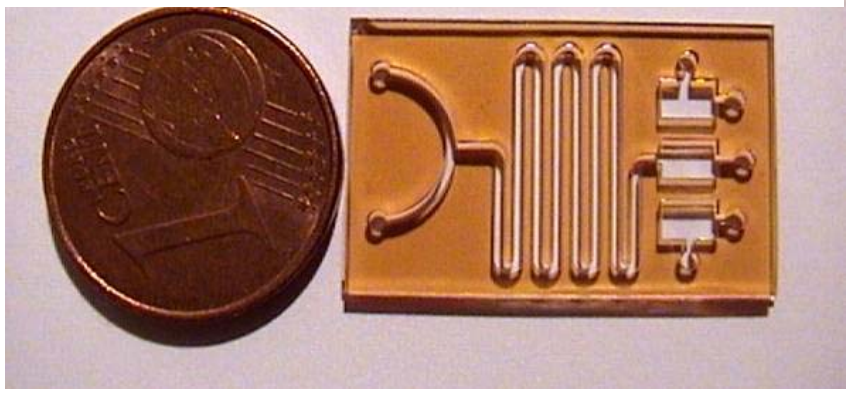
CMOS digital dental X-rays microsystem

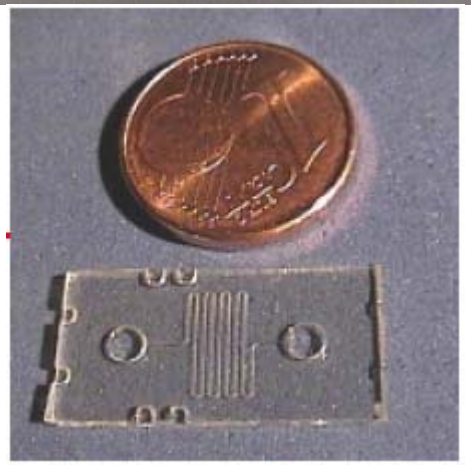


Lab-on-a-chip

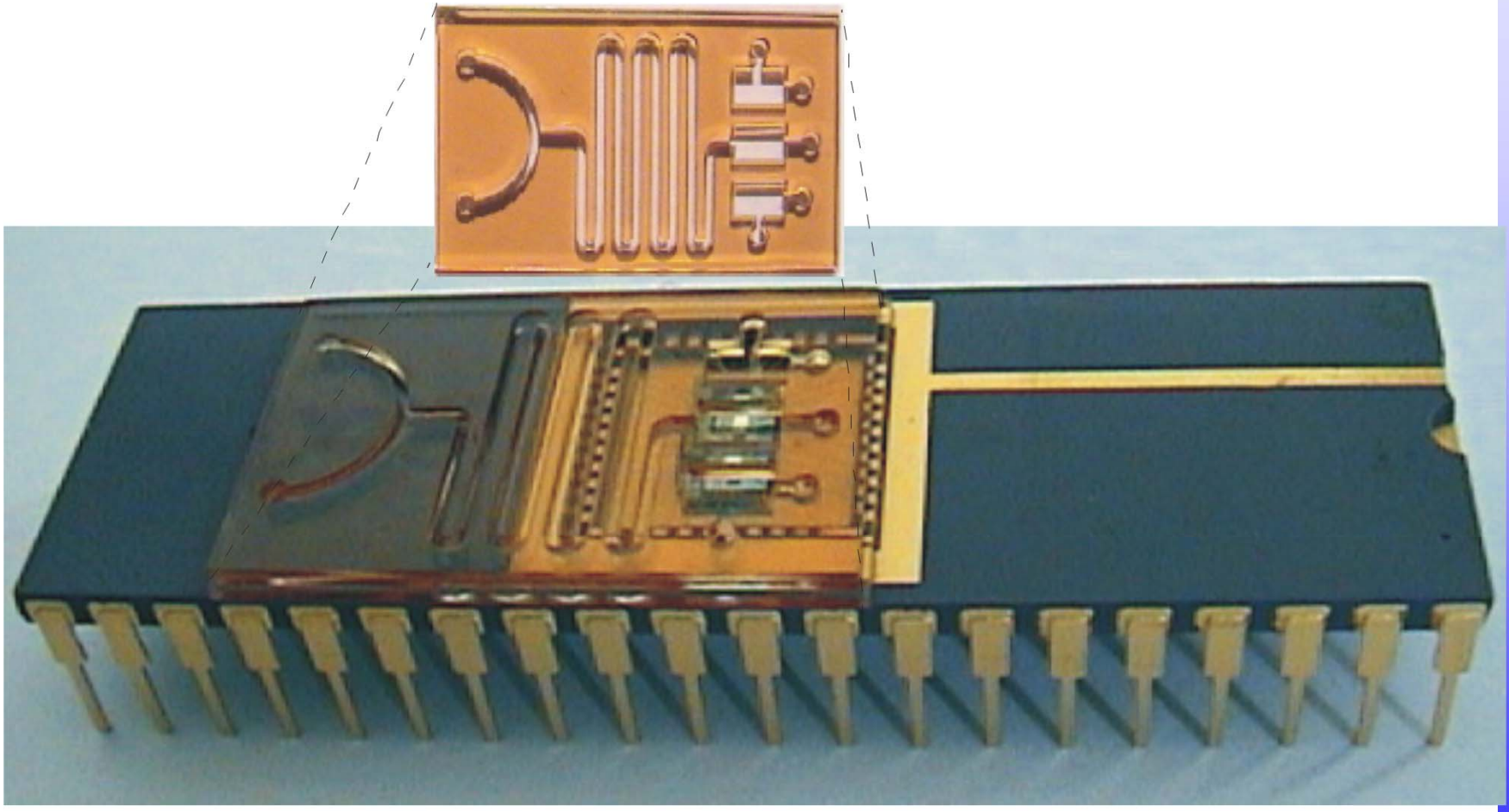

Electrophoresis channel
Electrodes
Outlet (waste)
Microchannels
Pyrex glass wafer
Inlet (sample)
Photodetector
Optical filter
Readout electronics
SiO_2
Inlet (reagent)
Silicon wafer



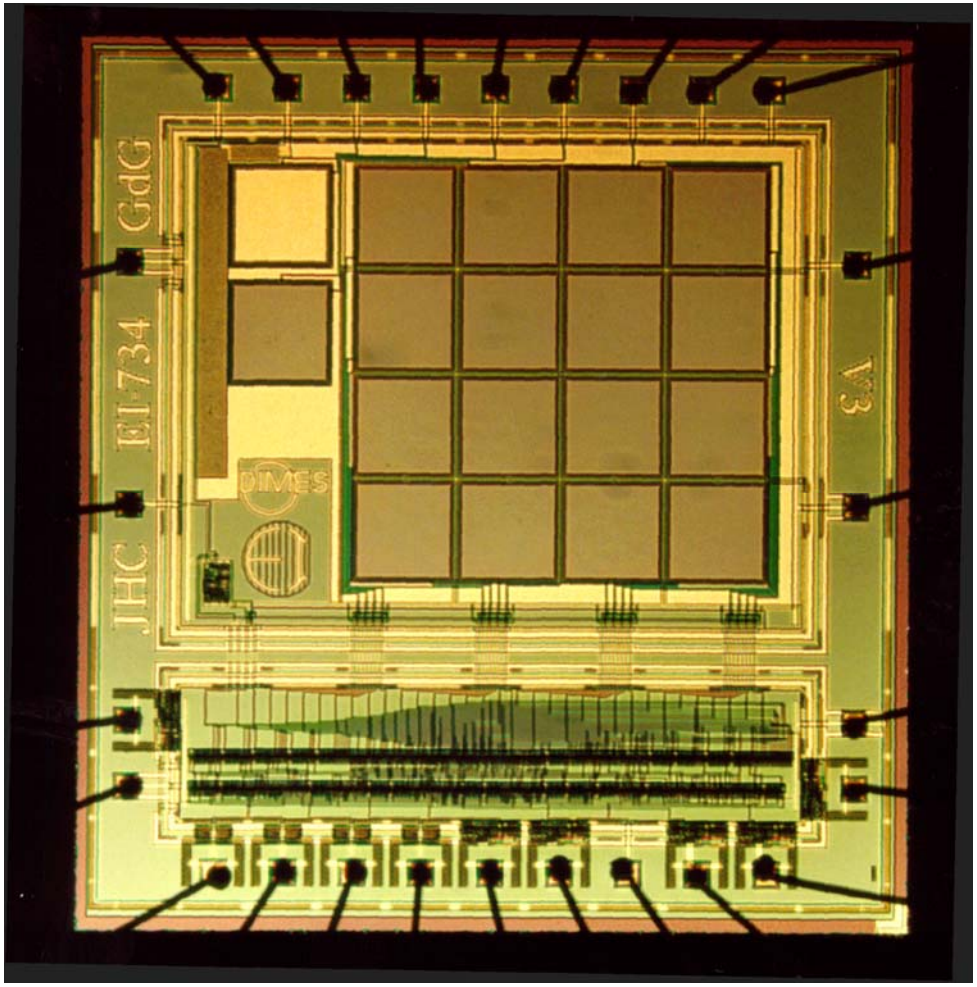




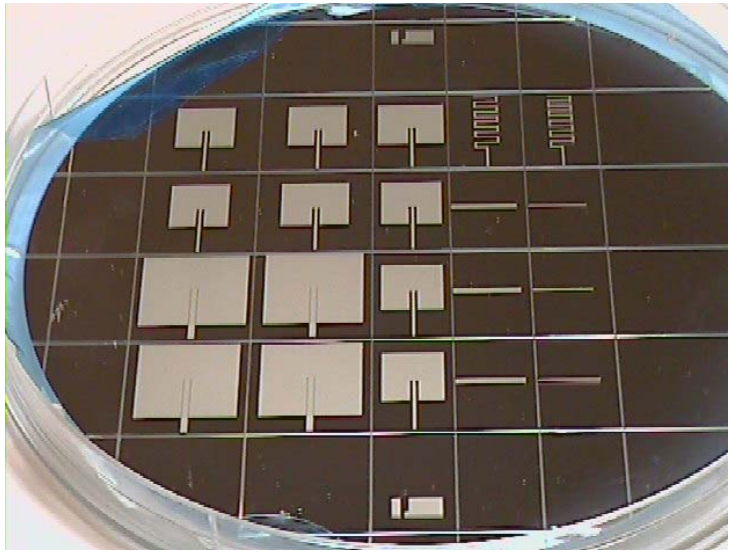
LAB-ON-A-CHIP for uric acid



Microspectrometer for UV, visible and IV with digital output and bus interface

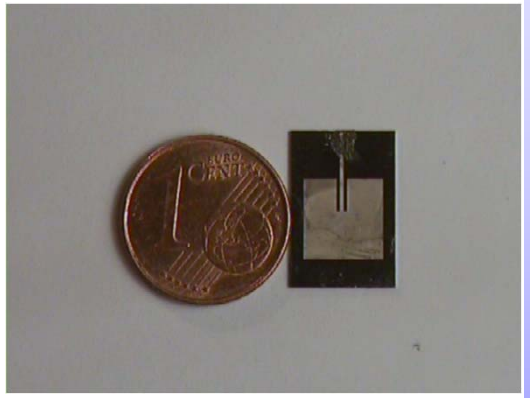


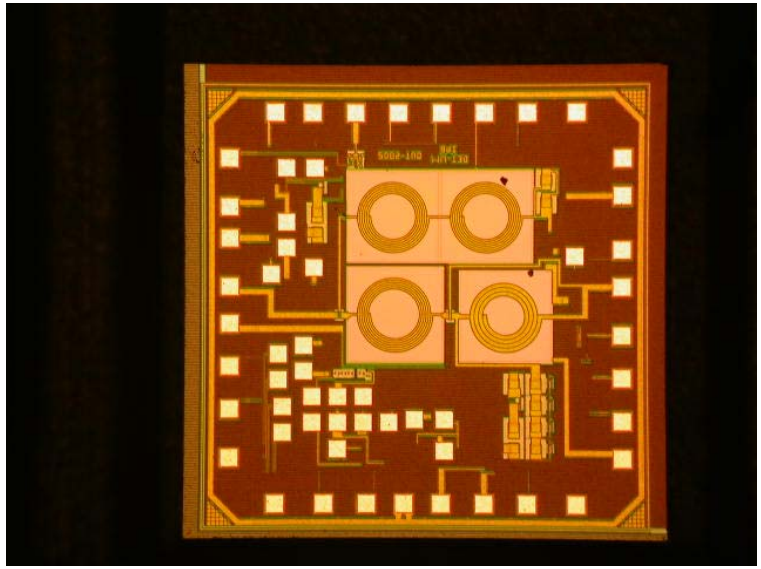
Chip-size antennas, RF CMOS 0.18 um



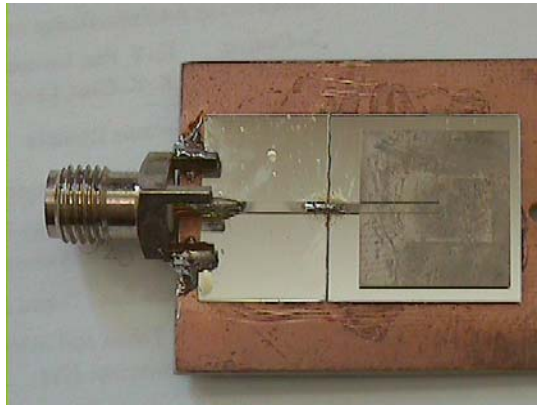
HRS (7x7mm^2)

HRPS (7x7mm^2)

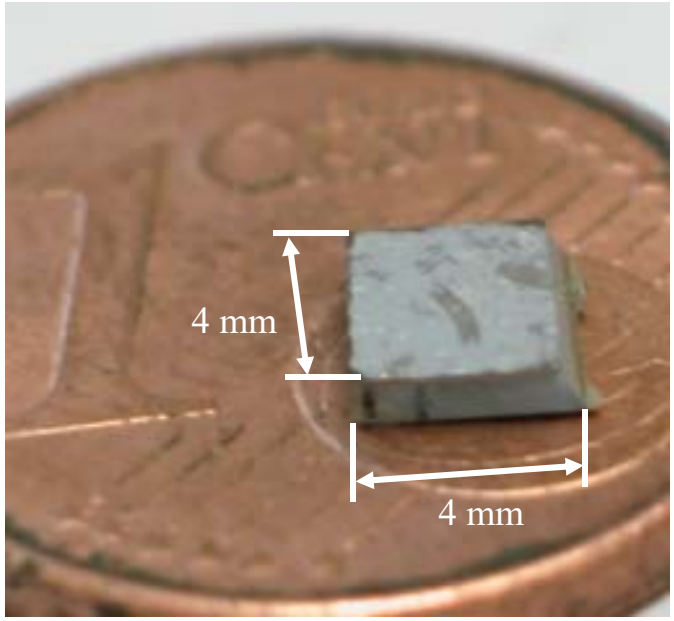


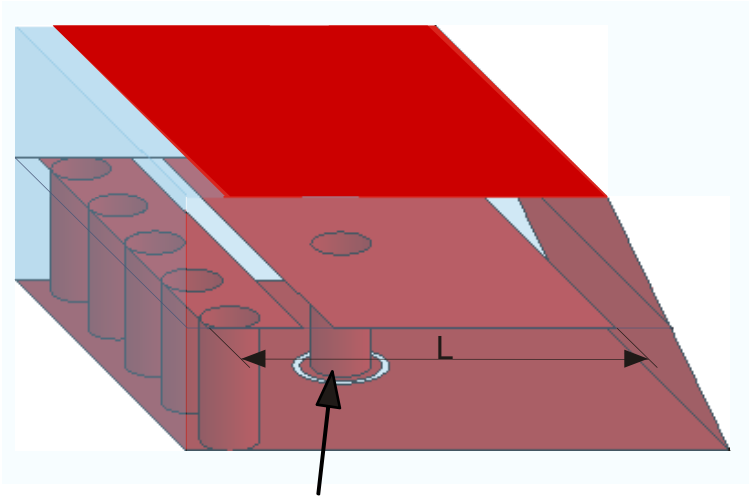


Glass (12x12mm^2)

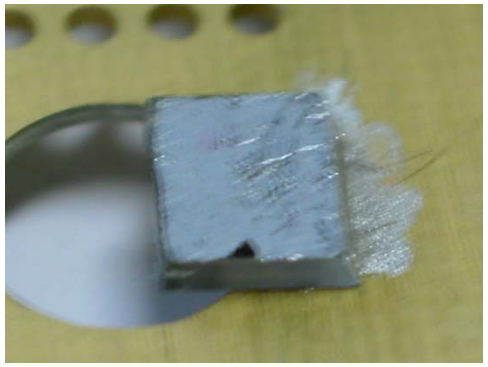


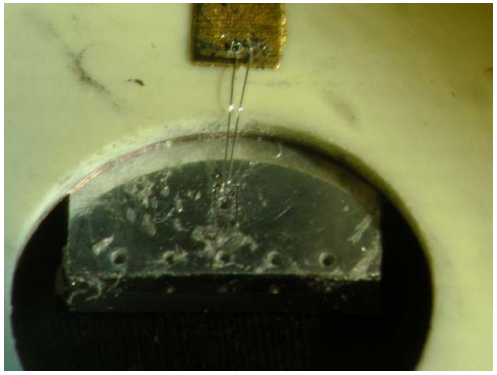
Chip-size antennas II





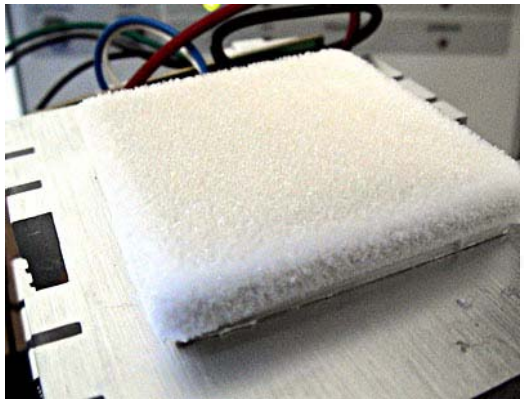
Alimentação





Peltier effect for cooling Applications

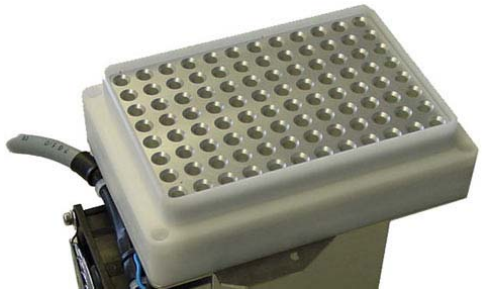
Cooling enough to get ice



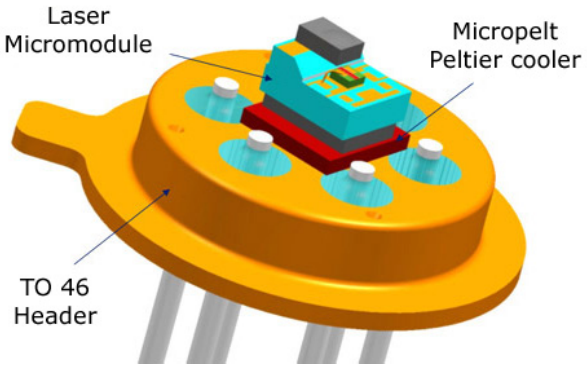
Feet or body Cooling ?

CPU Cooler

AMD Drives Integrated Peltier Cooling into Chips



Control small areas temperature arrays

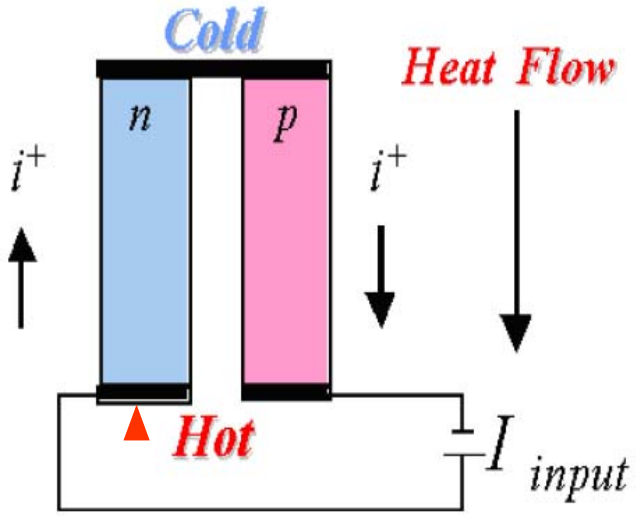


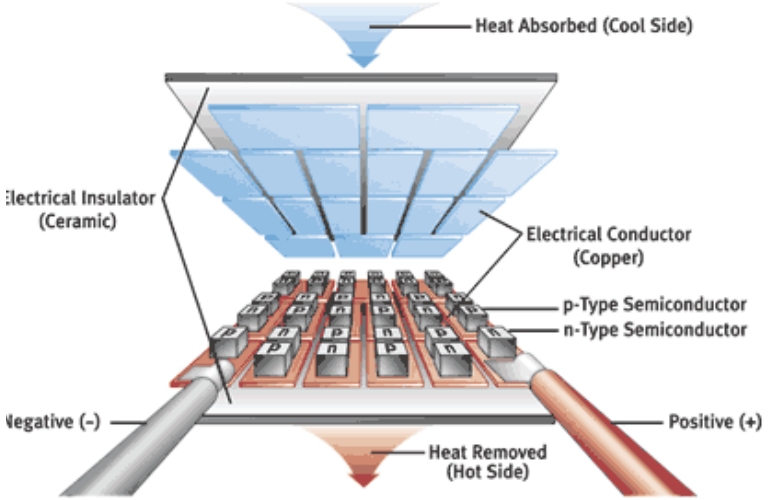
Laser chip temperature control

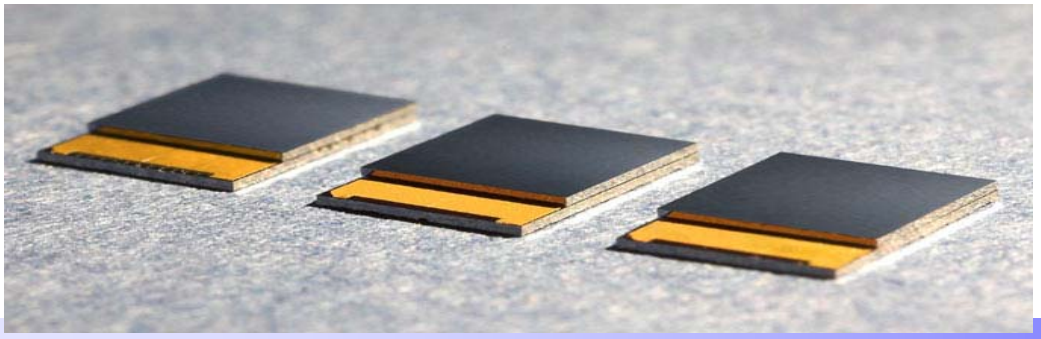
Peltier effect

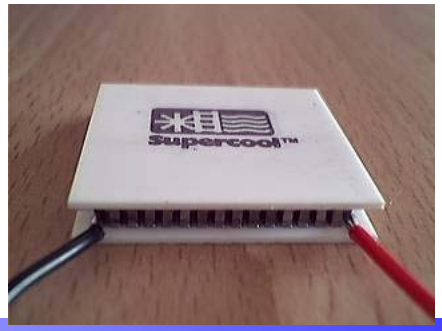
A current flowing through the junction of two materials generates / removes thermal energy

- **Solid state cooling devices**

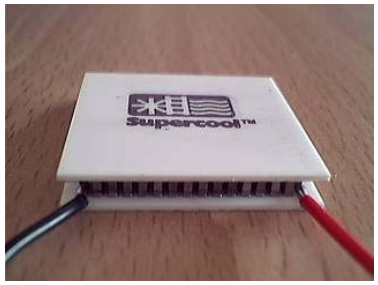


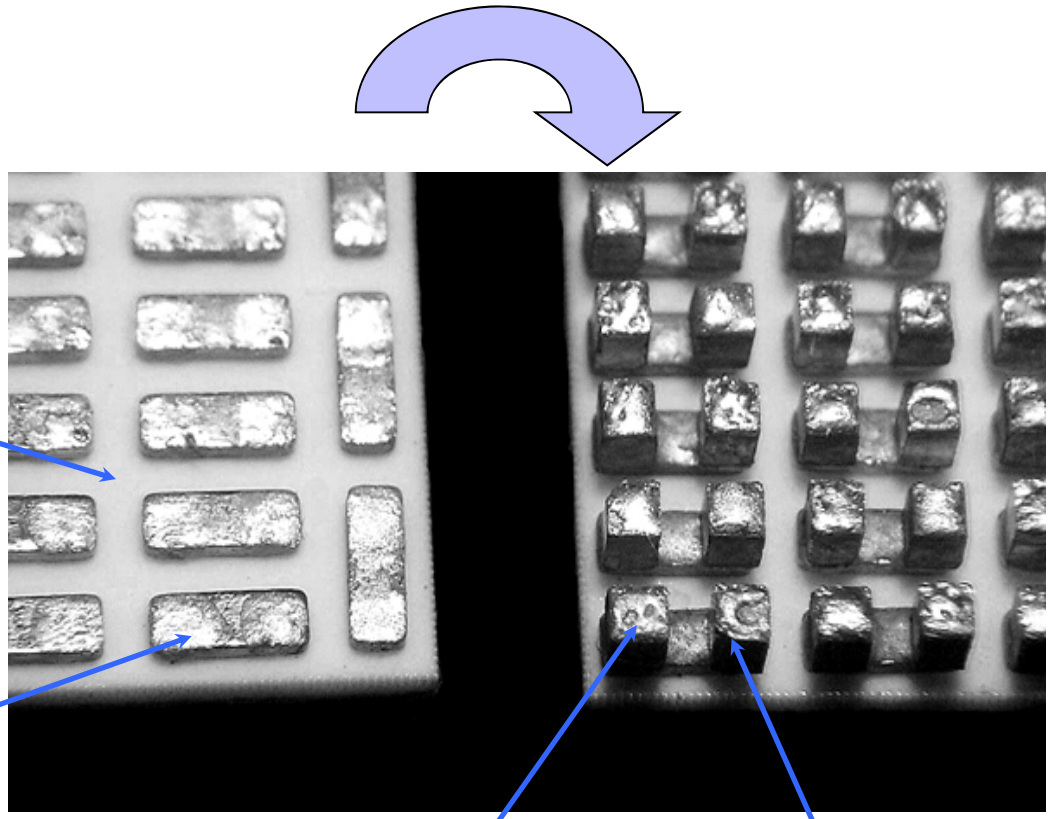






Inside a Peltier device





Ceramic plate
(Al_2O_3)

Conductor
Copper

TE* Elements (Pellets) – Bismuth Telluride / Antimony Telluride

* TE ⇔Thermoelectric

Good materiais for Peltier devices

- **High Seebeek coefficient α (*V/°C*)**
- **Low electrical resistivity ρ (*Ohm-m*)**
- **Low thermal conductivity λ (*$Wm^{-1}K^{-1}$*)**

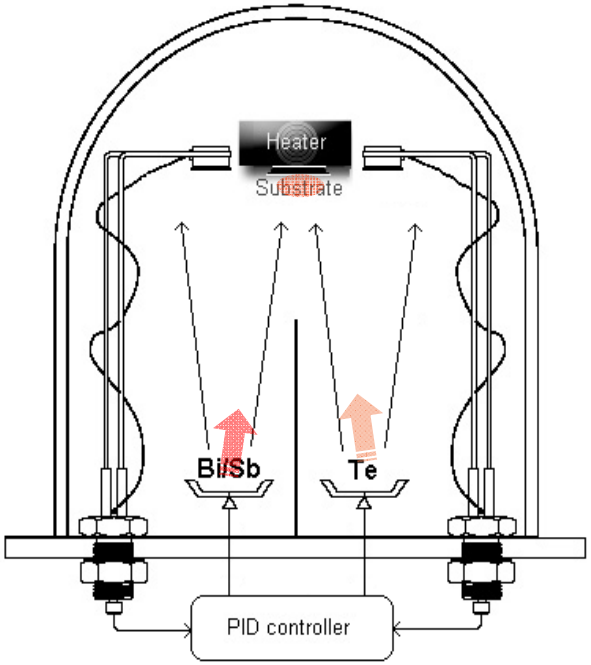
Figure of merit
(at temperature T)

$$ZT = \frac{\alpha^2}{\rho.\lambda}.T$$

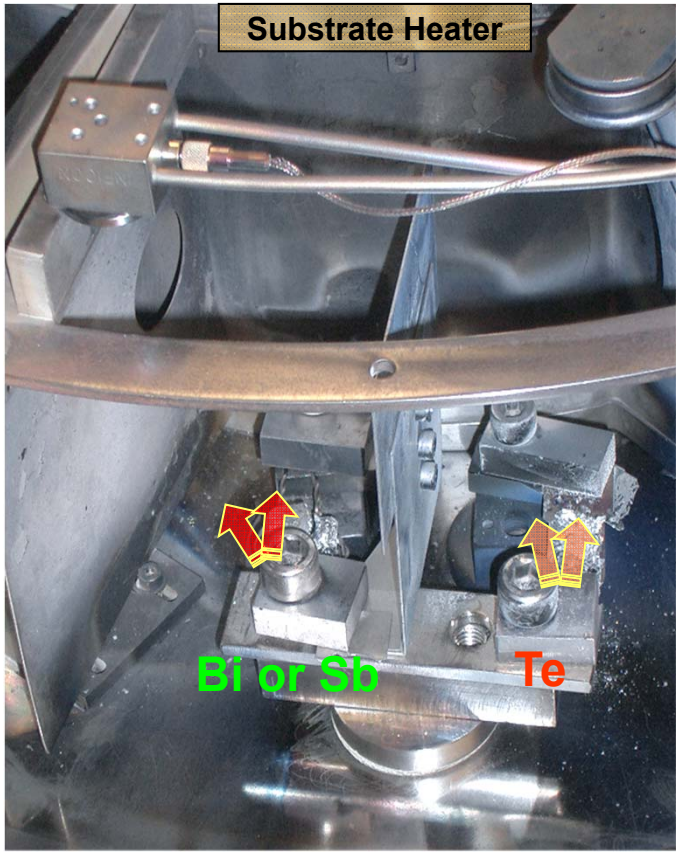
n-type: Bi_2Te_3 – Bismuth telluride

p-type: Sb_2Te_3 – Antimony telluride

Fabrication technique



Thermal co-evaporation



- 2 crucibles (Bi/Sb and Te)
- Power controlled by PID
- Constant evaporating rate
- Two oscillating crystals
- Substrate heated
- Deposition very slow: 2 µm/h

Seebeck effect Applications

Thermoelectric generators in space

High reliability

Citizen Eco Drive Thermo
Powered from body heat

Thermoelectric microsystem