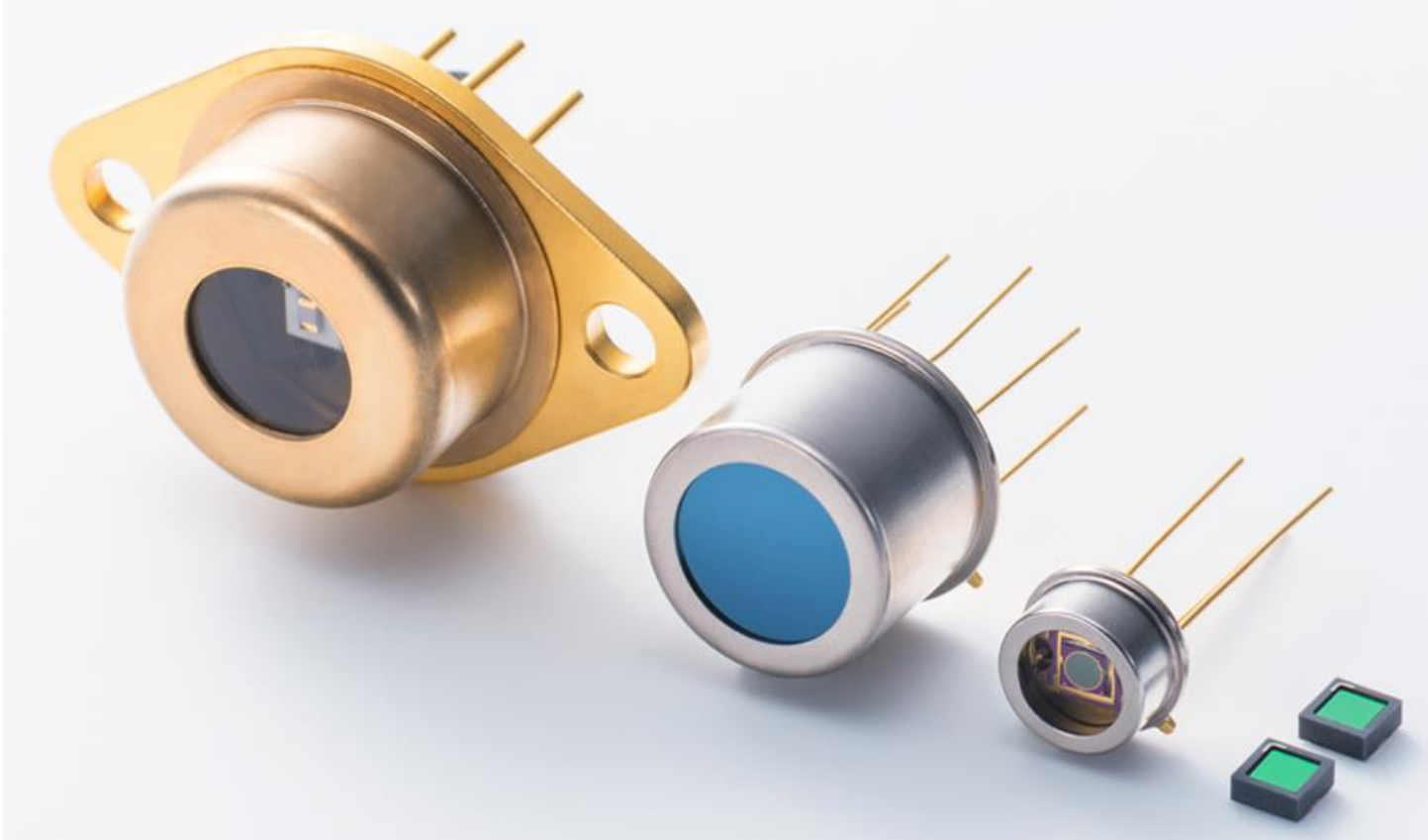# EPIC Online Technology Meeting on Environmental Monitoring

Adnan Quazi
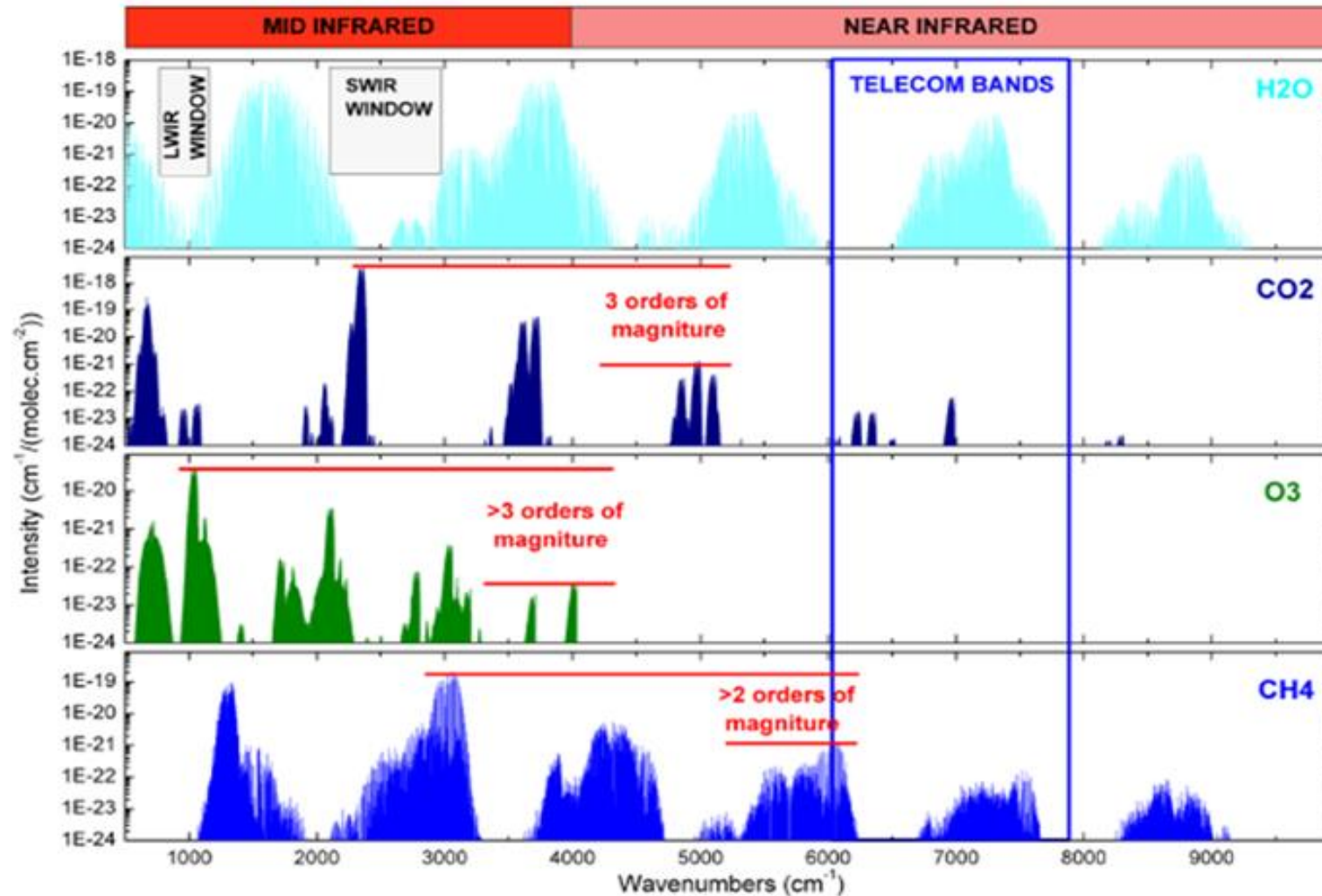
Sales Engineer HPUK

15.06.20

Multistage InAsSb: Hidden Champion of the Mid Infrared
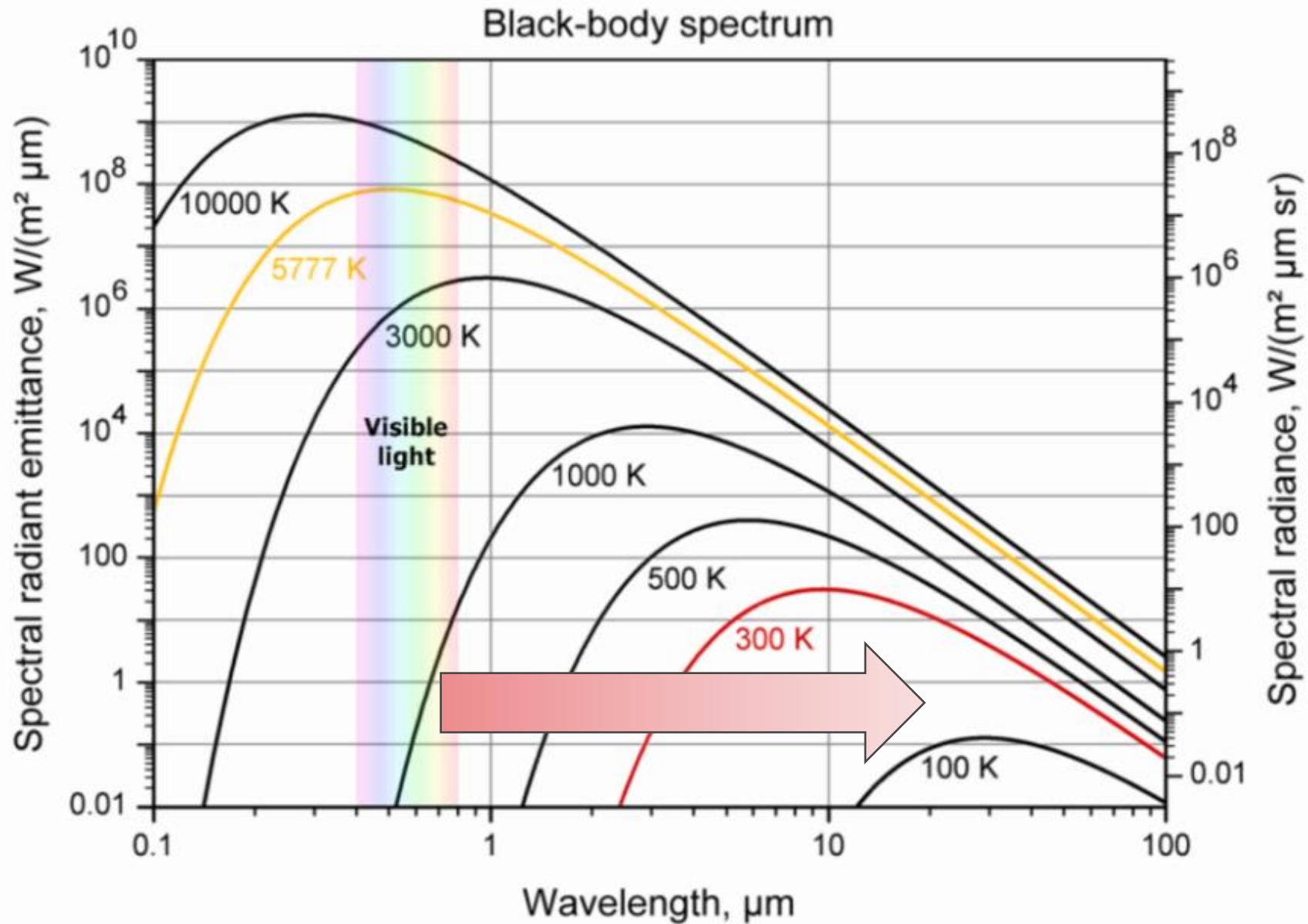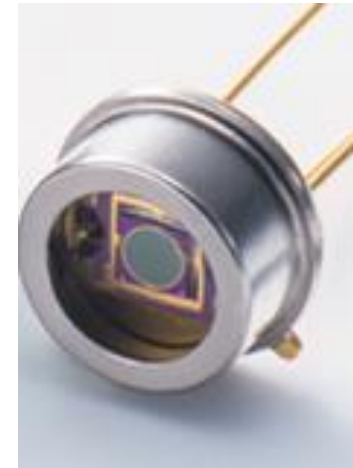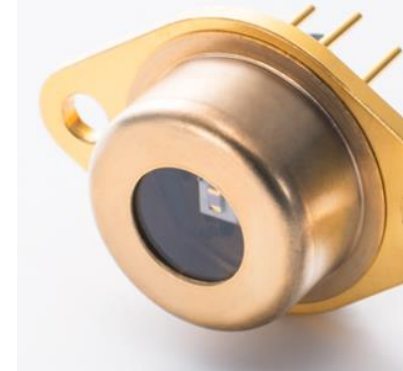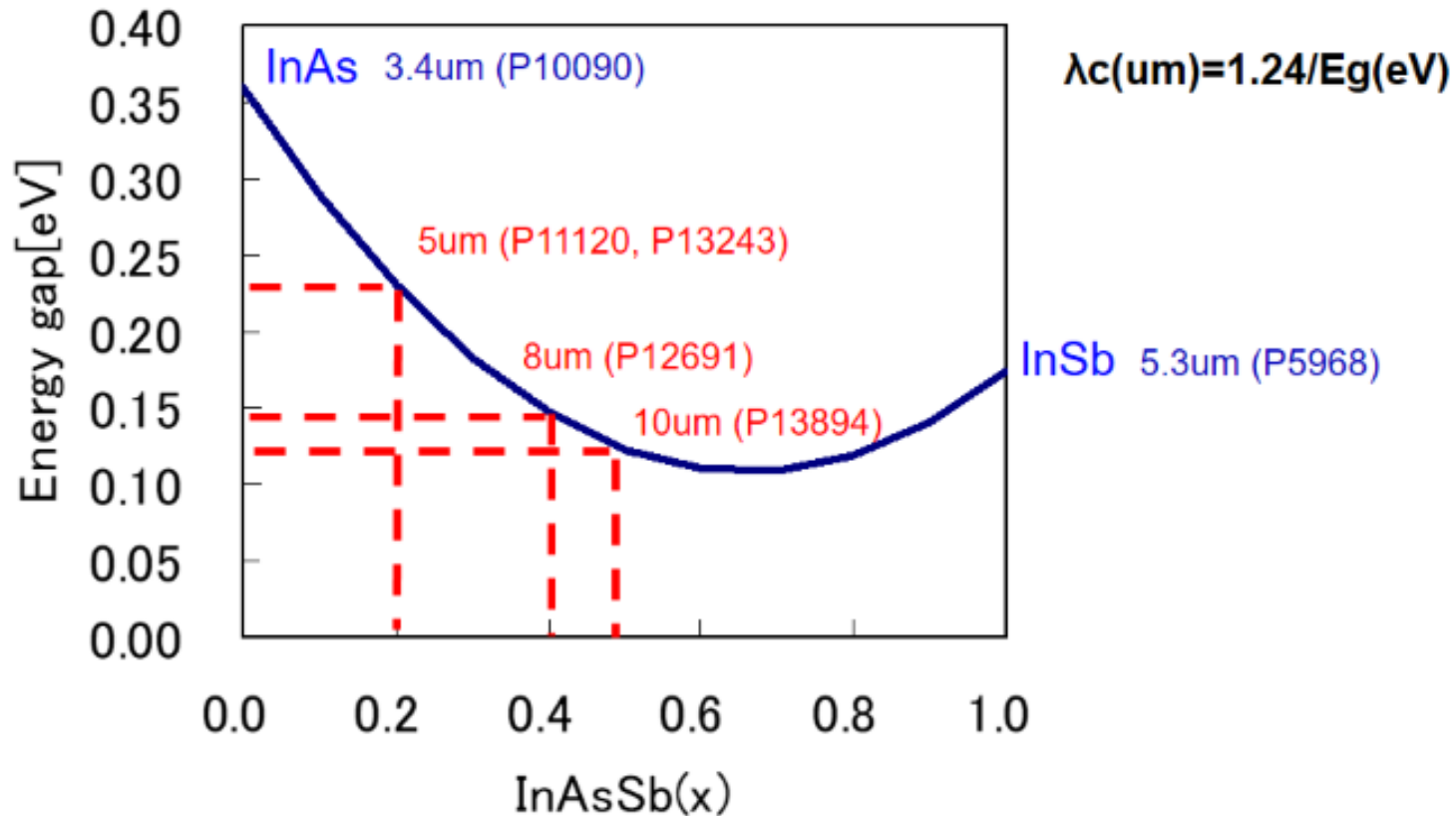
Why MIR for Environmental Monitoring?

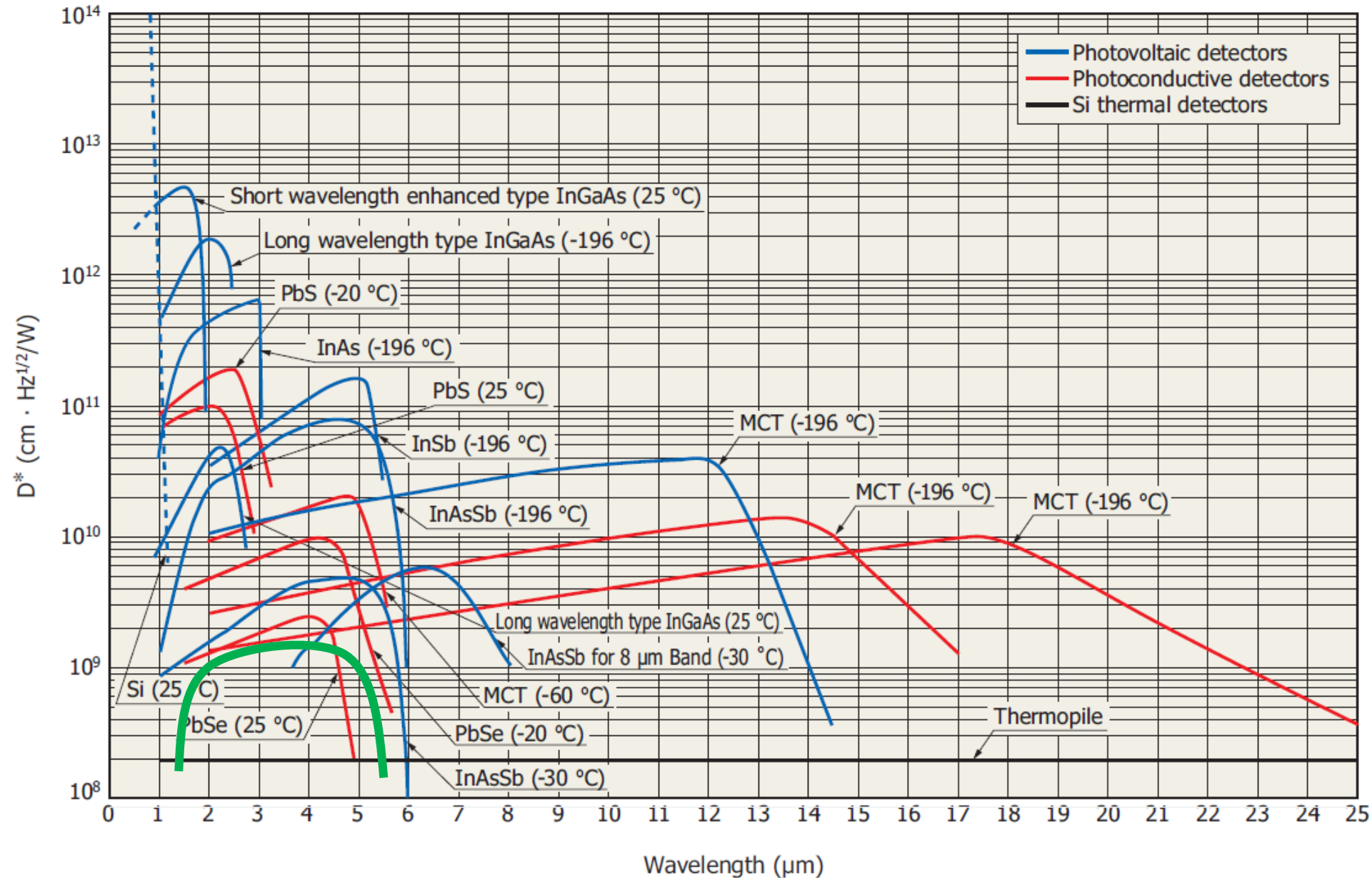-Space Tech, Warwick, 04 July 2011

Black-body spectrum

Disruptive Detectors: Multistage InAsSb

By varying the composition ratio of As / Sb, we can make a
detector having a cut-off wavelength from 3 to 12 um.

InAs 3.4um (P10090)

5um (P11120, P13243)

8um (P12691)

10um (P13894)

InSb 5.3um (P5968)

$\lambda c(um) = 1.24/Eg(eV)$

Energy gap[eV] vs InAsSb(x)

D* Comparison

D*: Specific Detectivity

$$D^* = \frac{\sqrt{A \Delta f}}{NEP}$$

- **NEP: The amount power needed to be input into a Detector in to equal the total noise produced by the Detector.**

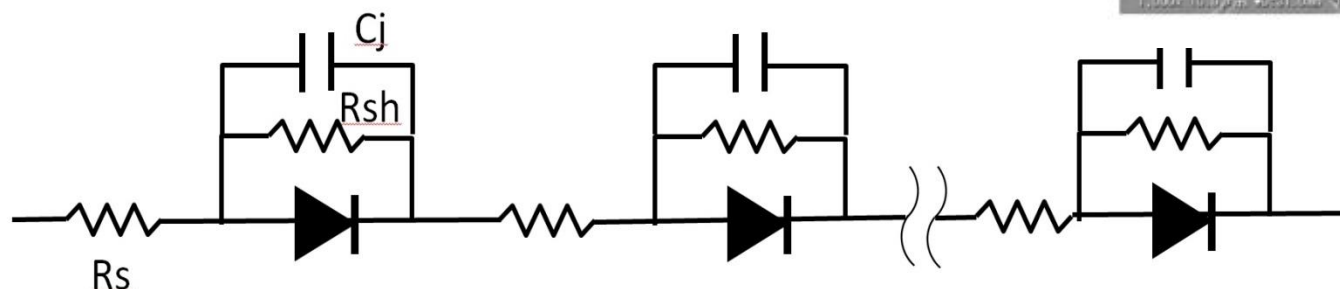- **Does not give a measure for how parasitic capacitance will impact noise.**

Structure of Multistage PD

What is a Multistage PD

⇒A photodiode having the structure
in which multi photodiodes are connected in series in one chip
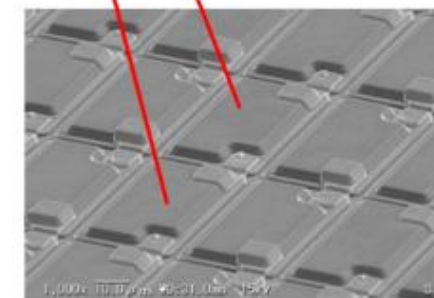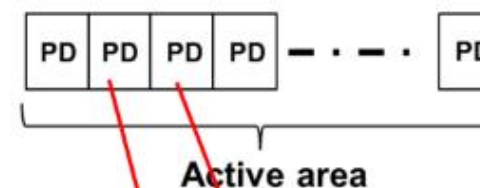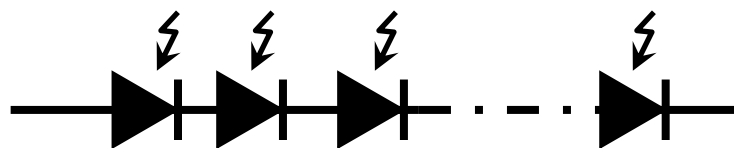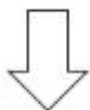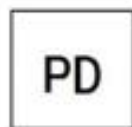
·Equivalent circuit

Characteristics of Multi-stage PD (output voltage: Voc)

Relationship between area and Voc.

In the case of active area is 5 times.

One PD Voc is 1V/W.

Multi-stage PD

PD

STD PD

5 PDs connected in series
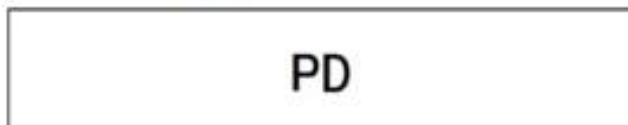
PD	PD	PD	PD	PD

Voc(Multi)=1+1+1+1+1=5V

The area is 5 times

but the signal is same.*

PD

Isc(STD)=1V

*It is close to a state where 5 diodes are connected in parallel.
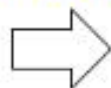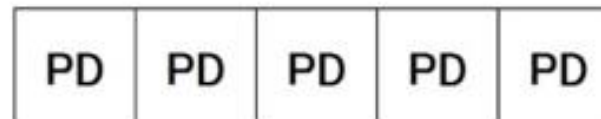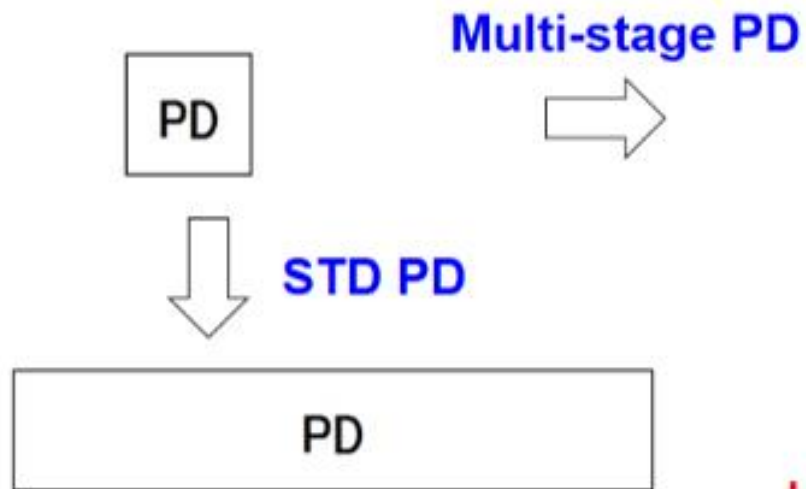
In the case of Multi-stage PD

Since five elements are connected in series, Voc becomes 5 times.

Characteristics of Multi-stage PD (Shunt resistance: Rsh)

Relationship between area and parallel resistance

In the case of active area is 5 times

One PD Rsh is 1Ω.

Multi-stage PD

PD

STD PD

PD

Rsh · (Active area)＝const.

Rsh(STD)=0.2Ω

5 PDs connected in series

PD	PD	PD	PD	PD
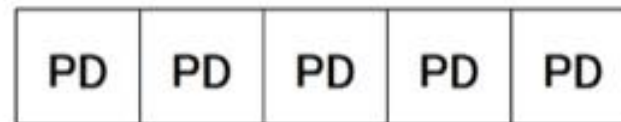
Rsh(Multi)=1+1+1+1+1=5Ω

In the case of Multi-stage PD

The resistance has a positive correlation with the active area.

Current mode
P13243-011CA with amp demo unit

trans-impedance amp

gain : 10M(V/A) X 10=100M(V/A)
Frequency :DC~1.6kHz

Reference

A measurement example
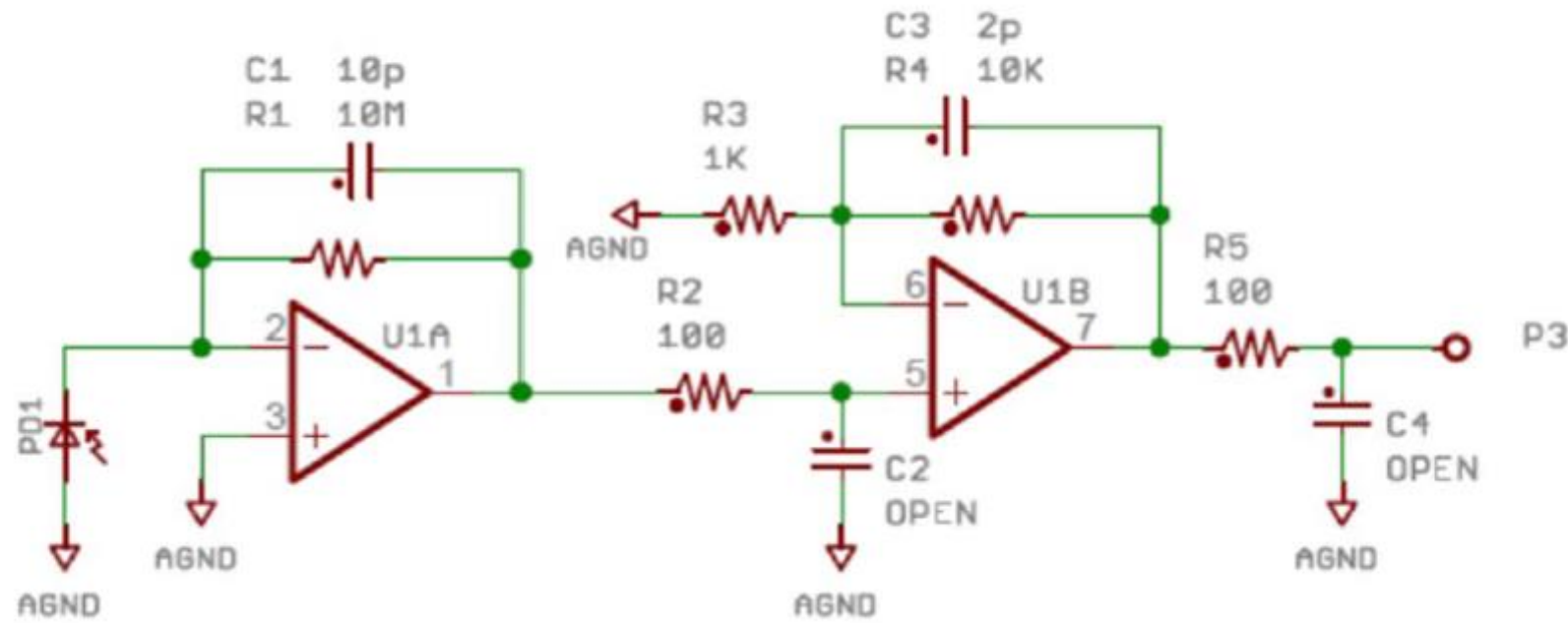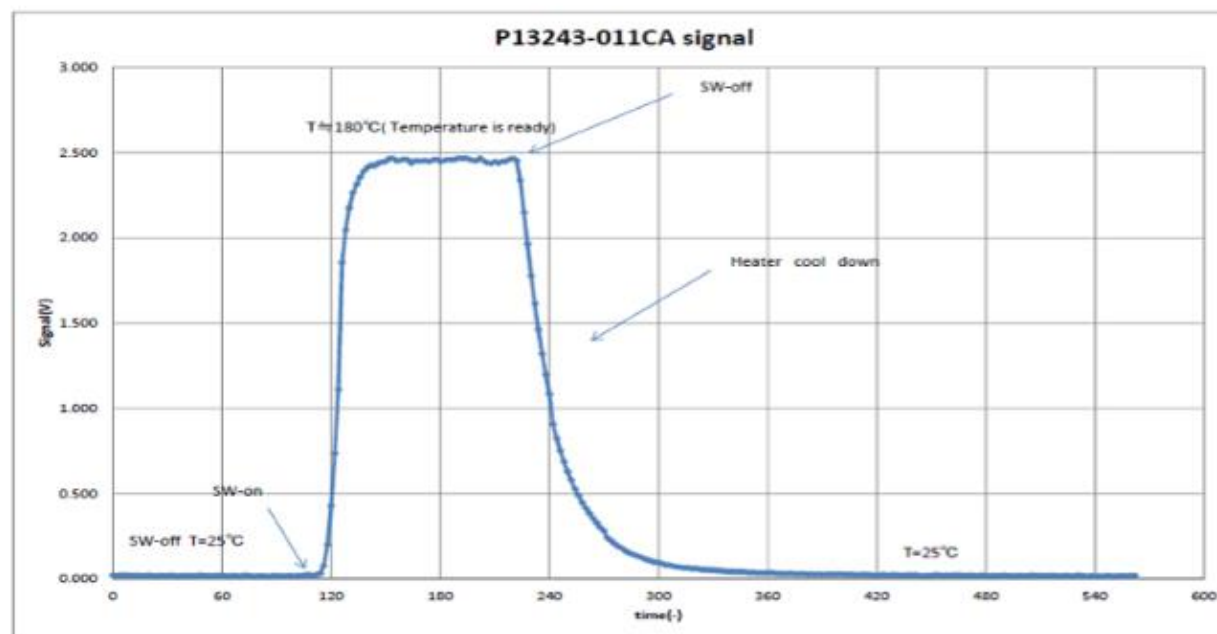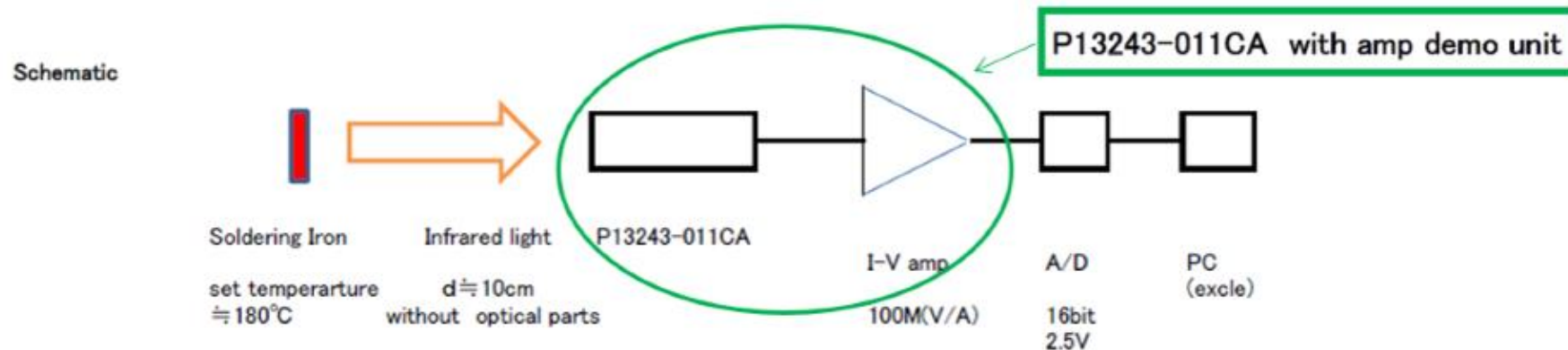## Non-contact temperature monitoring of the soldering iron

Schematic

P13243-011CA with amp demo unit

Soldering Iron   Infrared light   P13243-011CA   I-V amp   A/D   PC (excle)

set temperarture d≒10cm   100M(V/A) 16bit
≒180℃   without optical parts   2.5V

P13243-011CA signal

SW-off

T≒180℃(Temperature is ready)

Heater cool down

Reference

SW-on

SW-off T=25℃

T=25℃

InAsSb: Achieving greater SNR!

1. Multi-stage structure gives the detector much greater Rsh.

2. Large Rsh means much higher gain can be applied.

3. Very high gain – 10^12 can be applied.

4. High Rsh means noise is not amplified proportionately as much!

5. **2-3 orders of magnitude greater SNR can be achieved vs Monolithic InAsSb and PbS devices.**