Blood Chemistry Sensors

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Outline

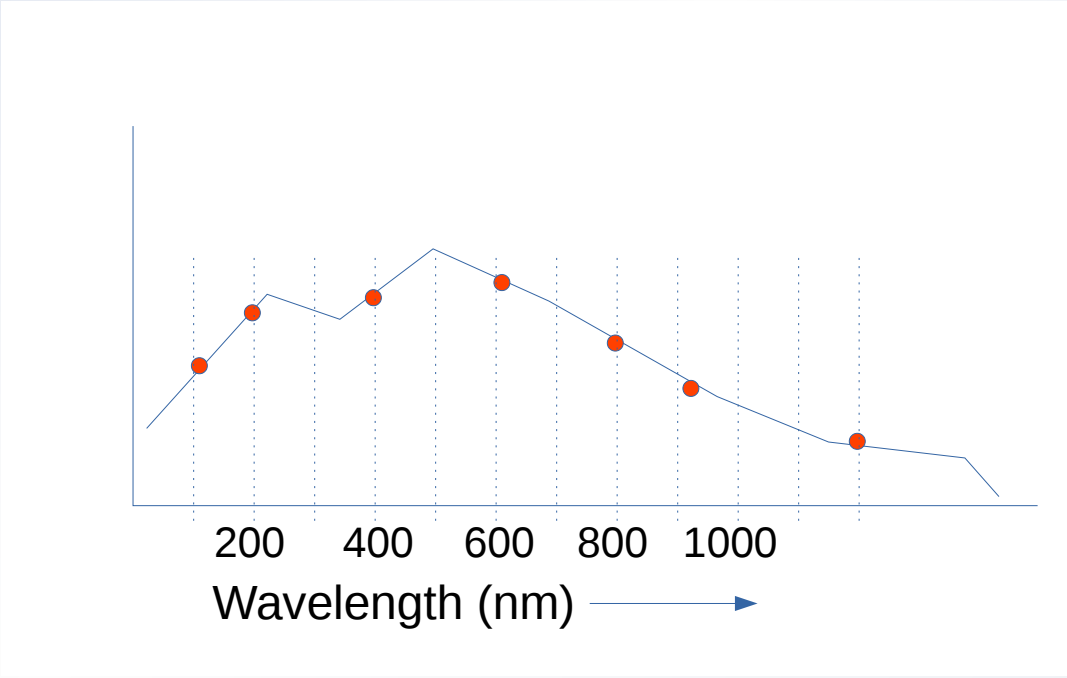
- pH sensors
- Oxygen sensors
- Glucose sensors
- CO2 sensors

Normal Ranges

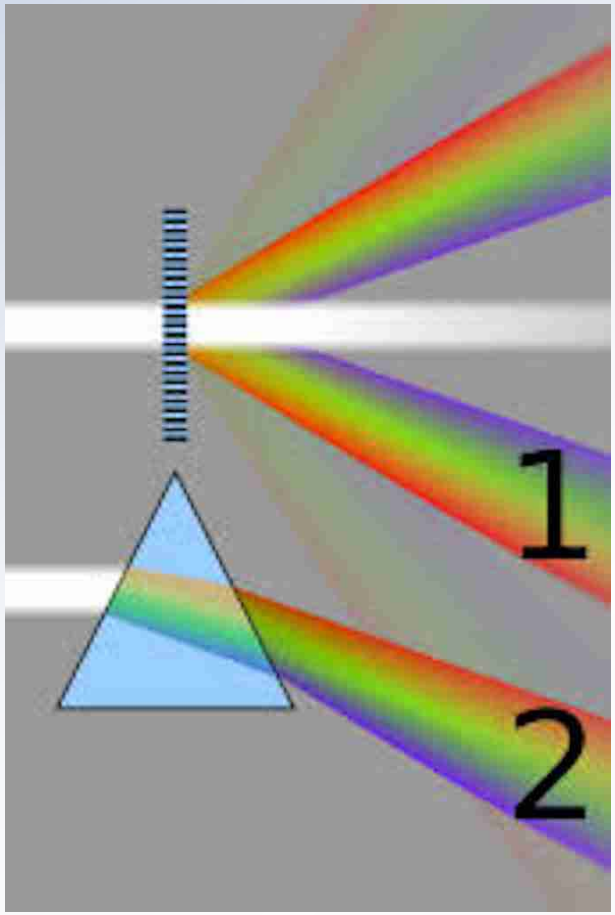
- PO_2: 80-104 mmHg
- PCO_2: 33-48 mmHg
- pH : 7.31-7.45
- Glucose: 70-110

Photospectrometry

- Estimate the spectrum of optical properties of a sample
- Measure intensity of light at few selected wavelengths



Optical Spectrum estimation



$$n\lambda = d\sin\theta$$

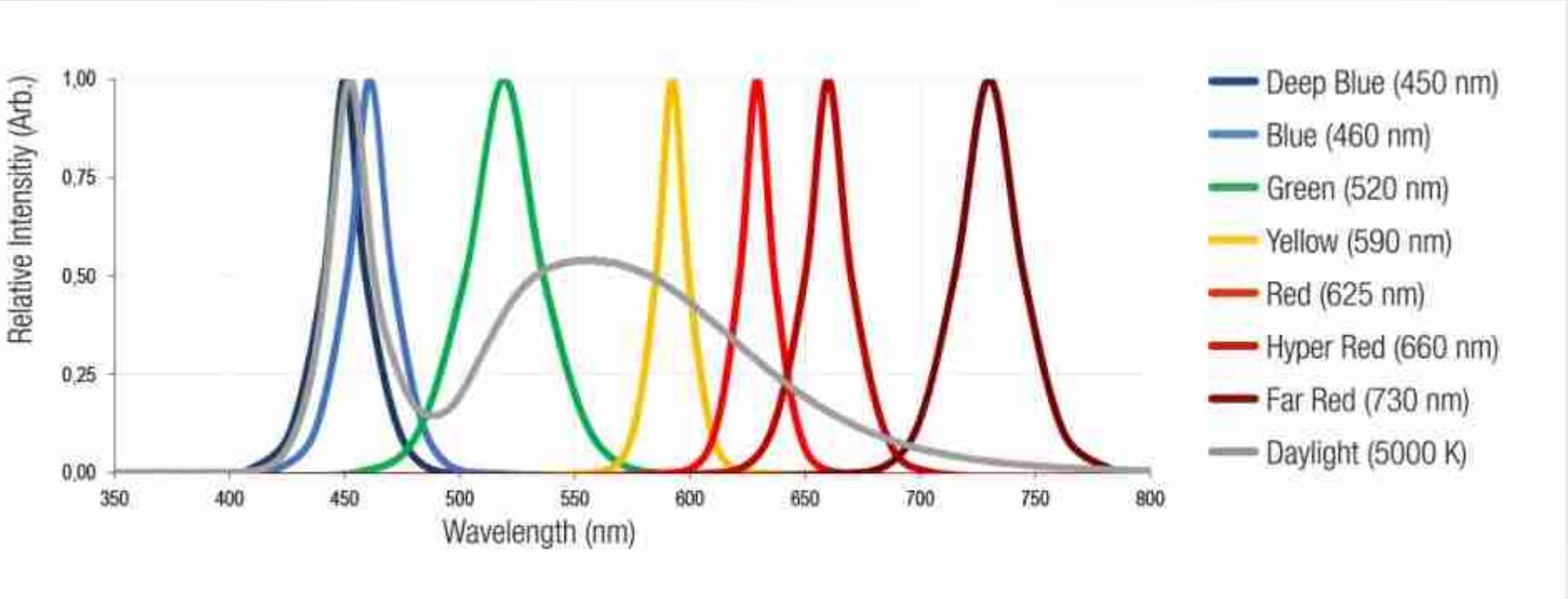
d = *grating spacing*

LED colours

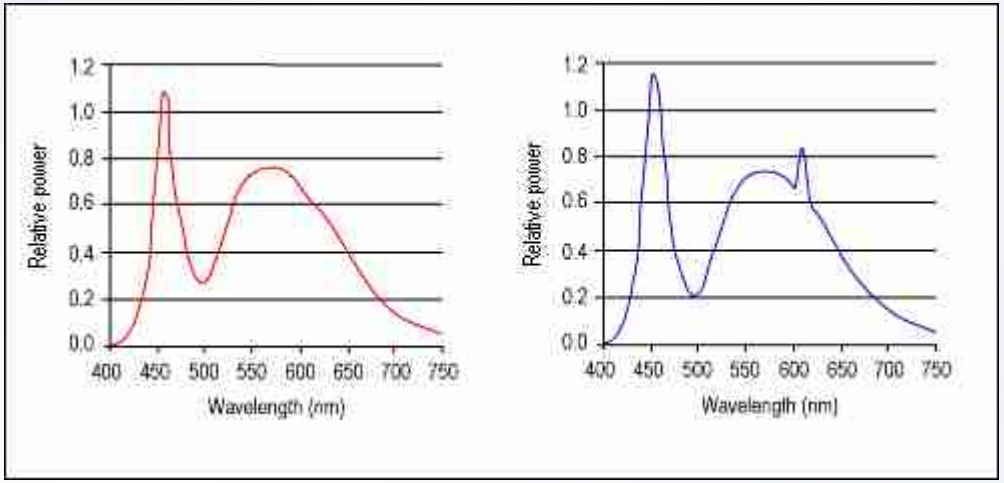
LED Color Guide

LED P/N Suffix	Description	Chemistry	# of Elements	Color Temperature (CCT Typ)	Peak Wavelength (λ / x-coord)	Dominant Wavelength (λ / y-coord)	Forward Voltage (Vf Typ)	Forward Voltage (Vf Max)	Brightness
H	High Efficiency Red	GaP	2	~	700	660	2.0	2.5	Standard
SR	Super Red	GaAlAs	3	~	660	640	1.7	2.2	High
SR	Super Red	AlInGaP	4	~	660	640	2.1	2.5	High
SI	Super High Intensity Red	AlnGaP	4	~	636	628	2.0	2.6	High
I	High Intensity Red	GaAsP	3	~	635	625	2.0	2.5	Standard
ZI	TS AlInGaP Red	AlInGaP	4	~	640	630	2.2	2.8	High
SO	Super Orange	AlInGaP	4	~	610	602	2.0	2.5	Standard
A	Amber	GaAsP	3	~	605	610	2.0	2.5	Standard
SY	Super Yellow	AlInGaP	4	~	590	588	2.0	2.5	Standard
ZY	TS AlInGaP Yellow	AlInGaP	4	~	590	589	2.3	2.8	High
Y	Yellow	GaAsP	3	~	590	588	2.1	2.5	Standard
SUG	Super Ultra Green	AlInGaP	4	~	574	568	2.2	2.6	High
G	Green	GaP	2	~	565	568	2.2	2.6	Standard
SG	Super Green	GaP	2	~	565	568	2.2	2.6	Standard
PG	Pure Green	GaP	2	~	555	555	2.1	2.5	Standard
UPG	Ultra Pure Green	InGaN	3	~	525	520	3.5	4.0	High
UEG	Ultra Emerald Green	InGaN	3	~	500	505	3.5	4.0	High
USB	Ultra Super Blue	InGaN	3	~	470	470	3.5	4.0	High
UV	Ultra Violet	InGaN	3	~	410	~	3.5	4.0	Standard
SUV	Super Violet	InGaN	3	~	380	~	3.4	3.9	Standard
T	Turquoise	InGaN	3	~	0.19	0.41	3.2	4.0	Standard
V	Violet / Purple	InGaN	3	~	0.22	0.11	3.2	4.0	Standard
P	Pink	InGaN	3	~	0.33	0.21	3.2	4.0	Standard
MW (Warm)	Warm White	InGaN	3	3000K	~	~	3.3	4.0	High
NW (Neutral)	Neutral White	InGaN	3	4000K	~	~	3.3	4.0	High
UW (Cool)	Cool White	InGaN	3	6000K	~	~	3.3	4.0	High

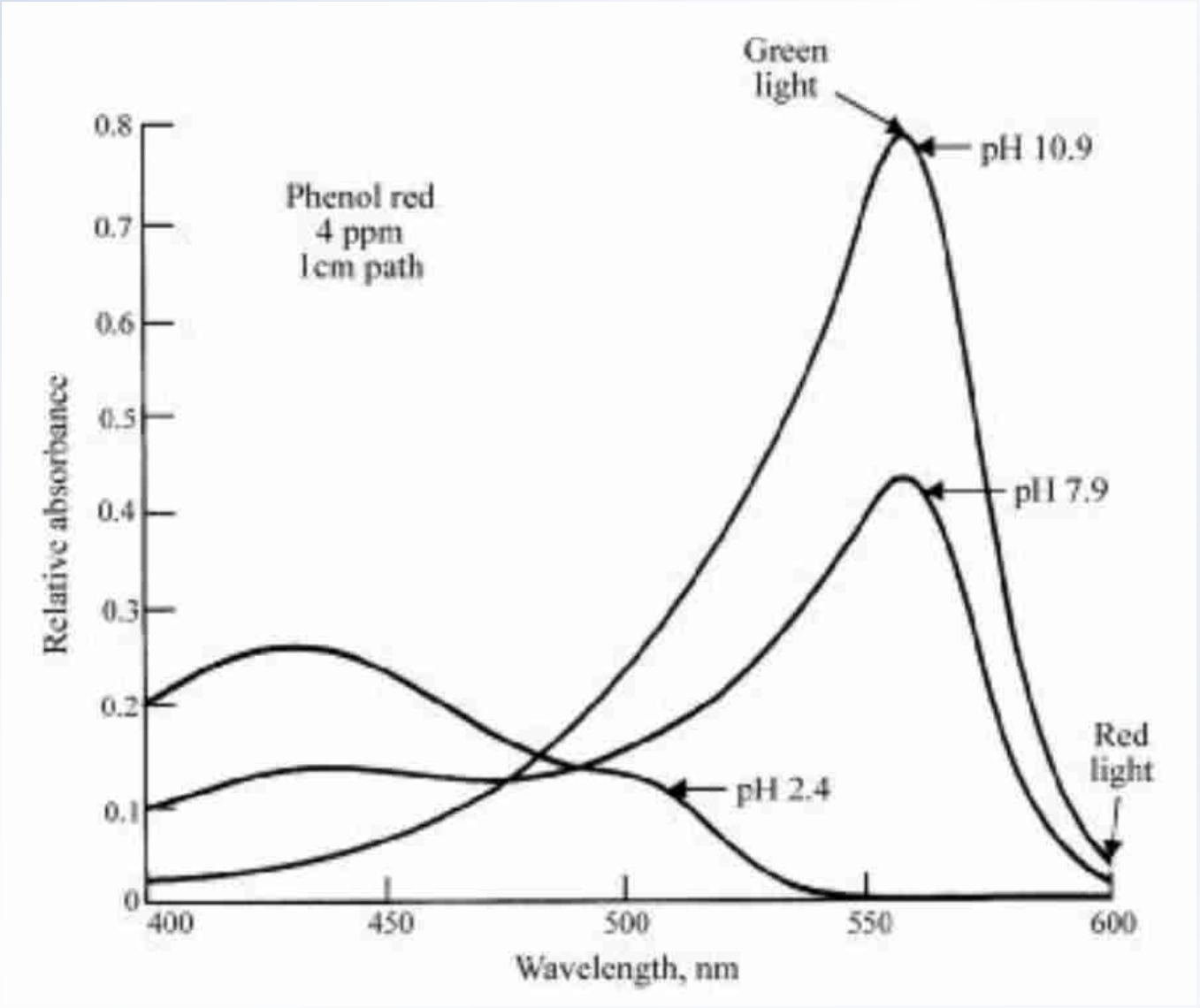
LED spectra


Relative Intensity (Arb.)
1,00
0,75
0,50
0,25
0,00
350
400
450
500
550
600
650
700
750
800
Wavelength (nm)
Deep Blue (450 nm)
Blue (460 nm)
Green (520 nm)
Yellow (590 nm)
Red (625 nm)
Hyper Red (660 nm)
Far Red (730 nm)
Daylight (5000 K)

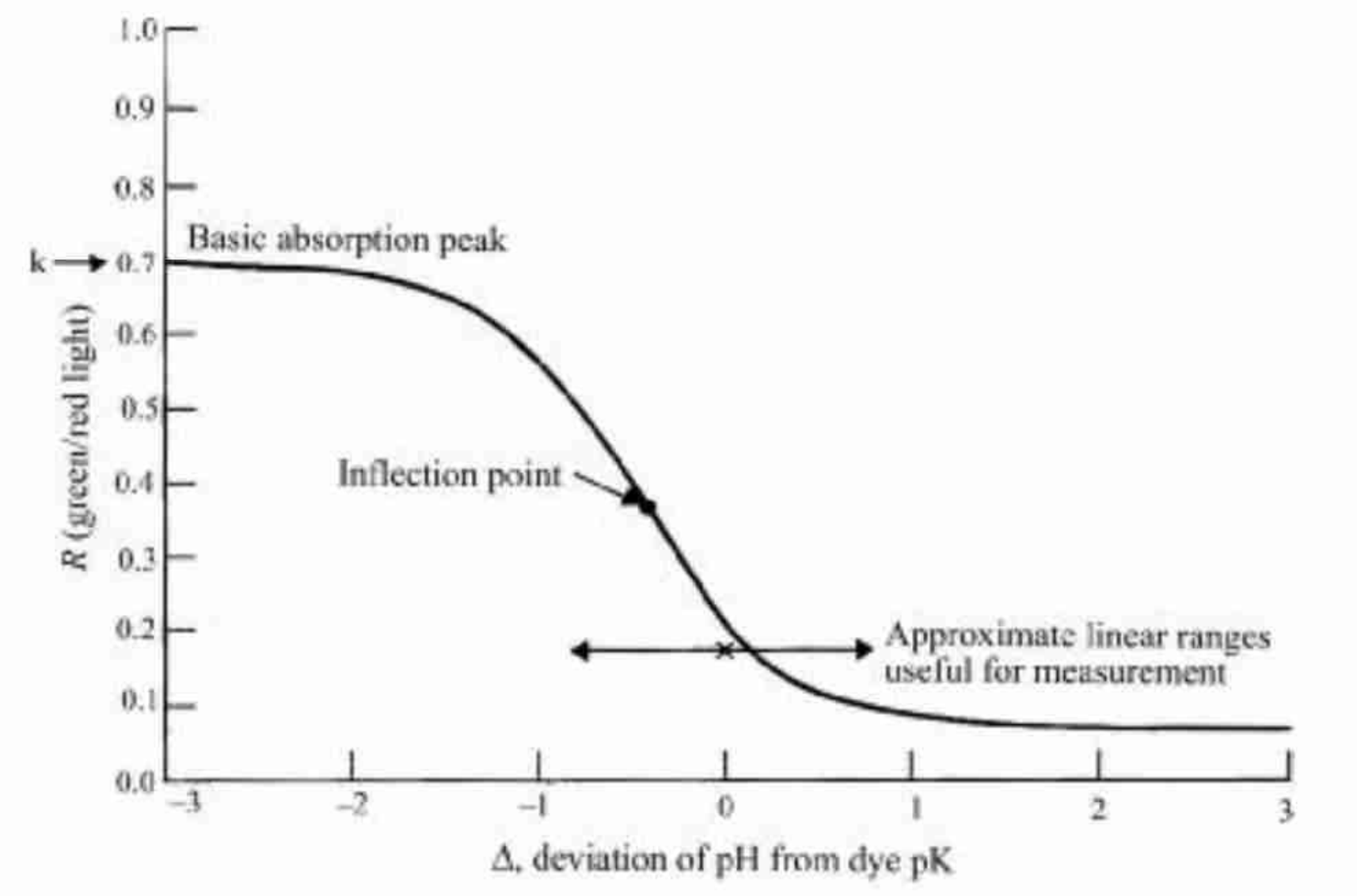
White light using phosphor coated blue LEDs



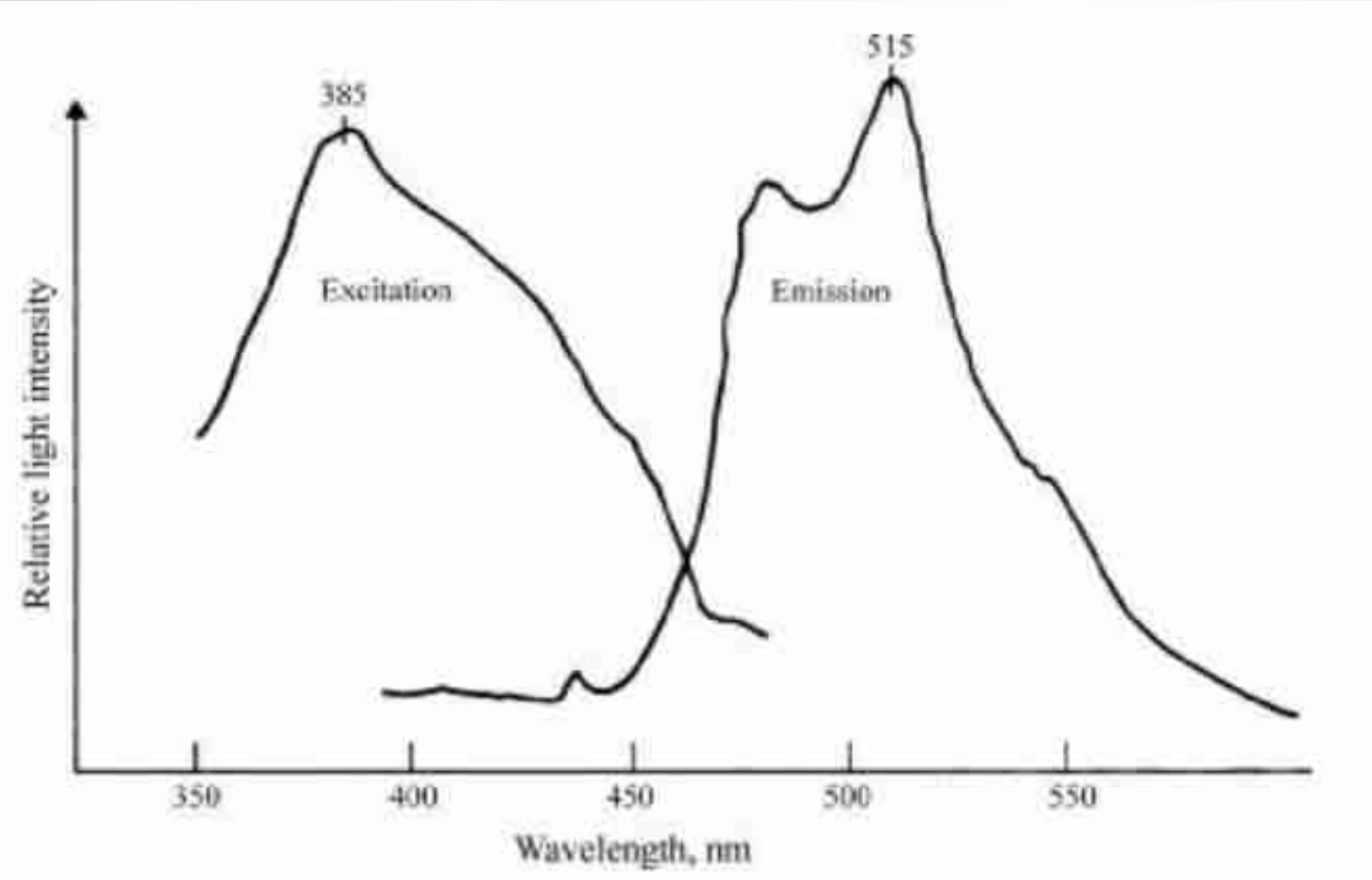
Absorption spectrum change of phenol red with pH



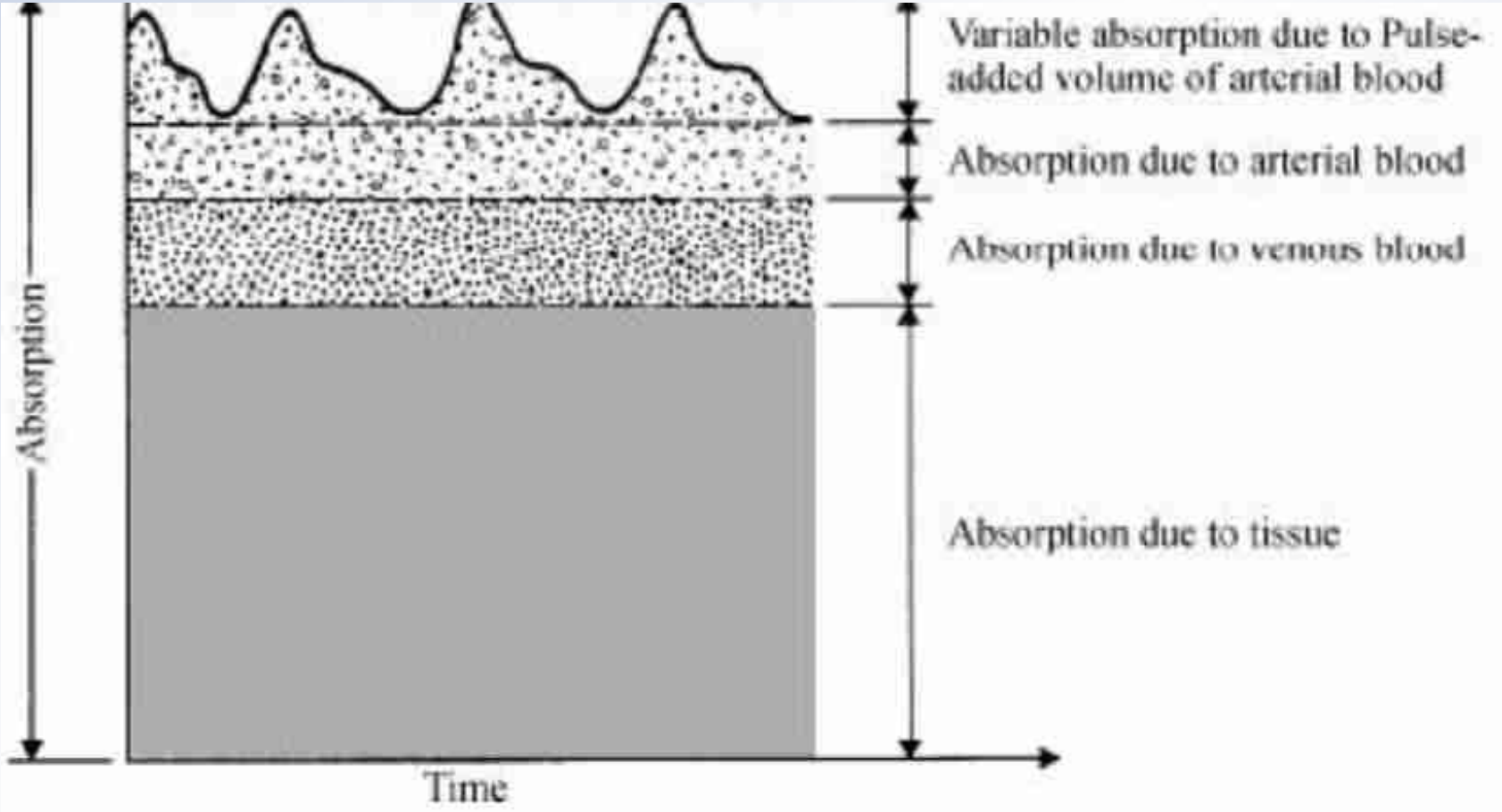
Peak spectrum shift of phenol red with pH



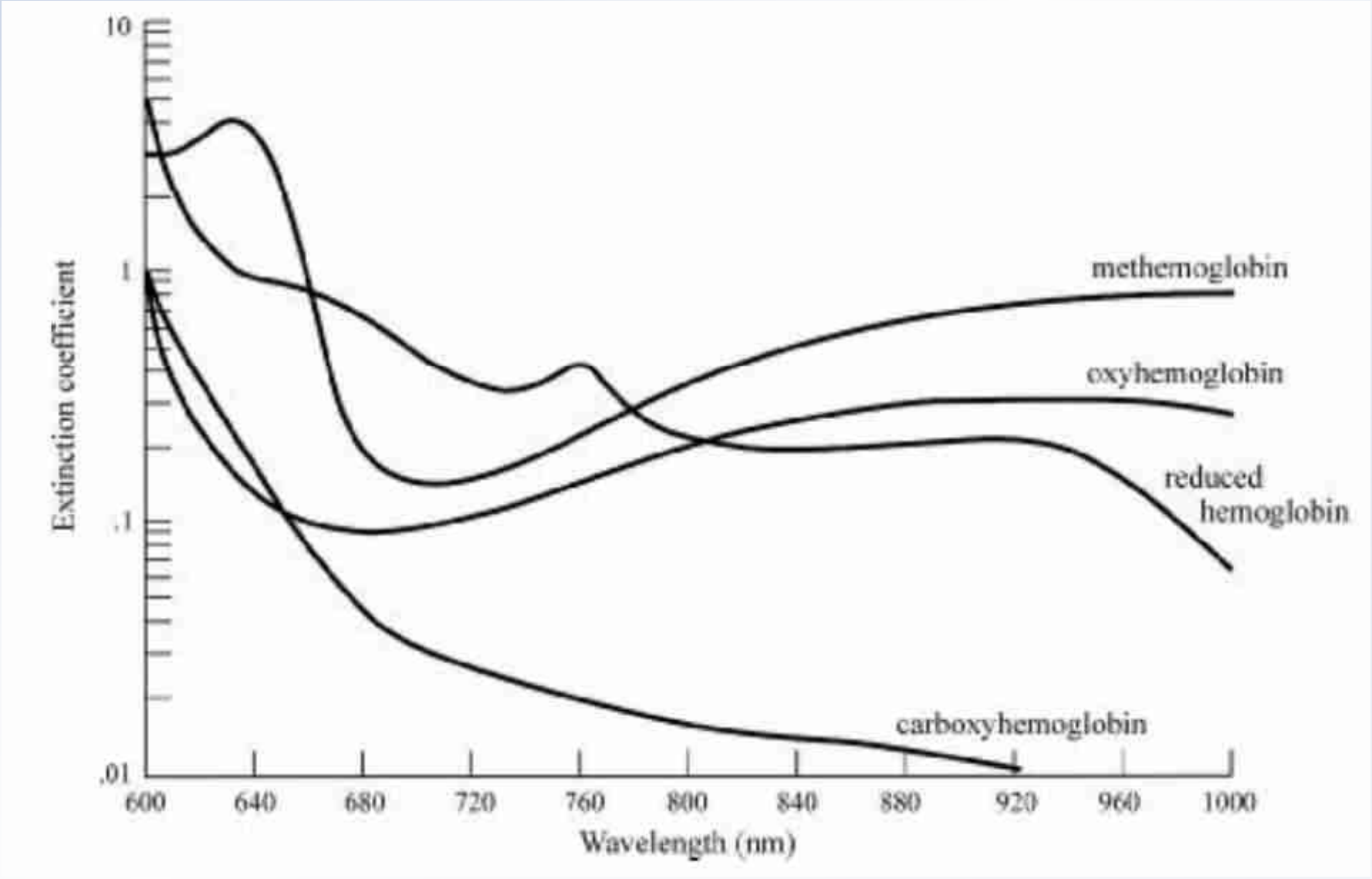
O_2 fluorescence dye (e.g., Anthracenecarboxaldehyde, $C_{15}H_{10}O$)



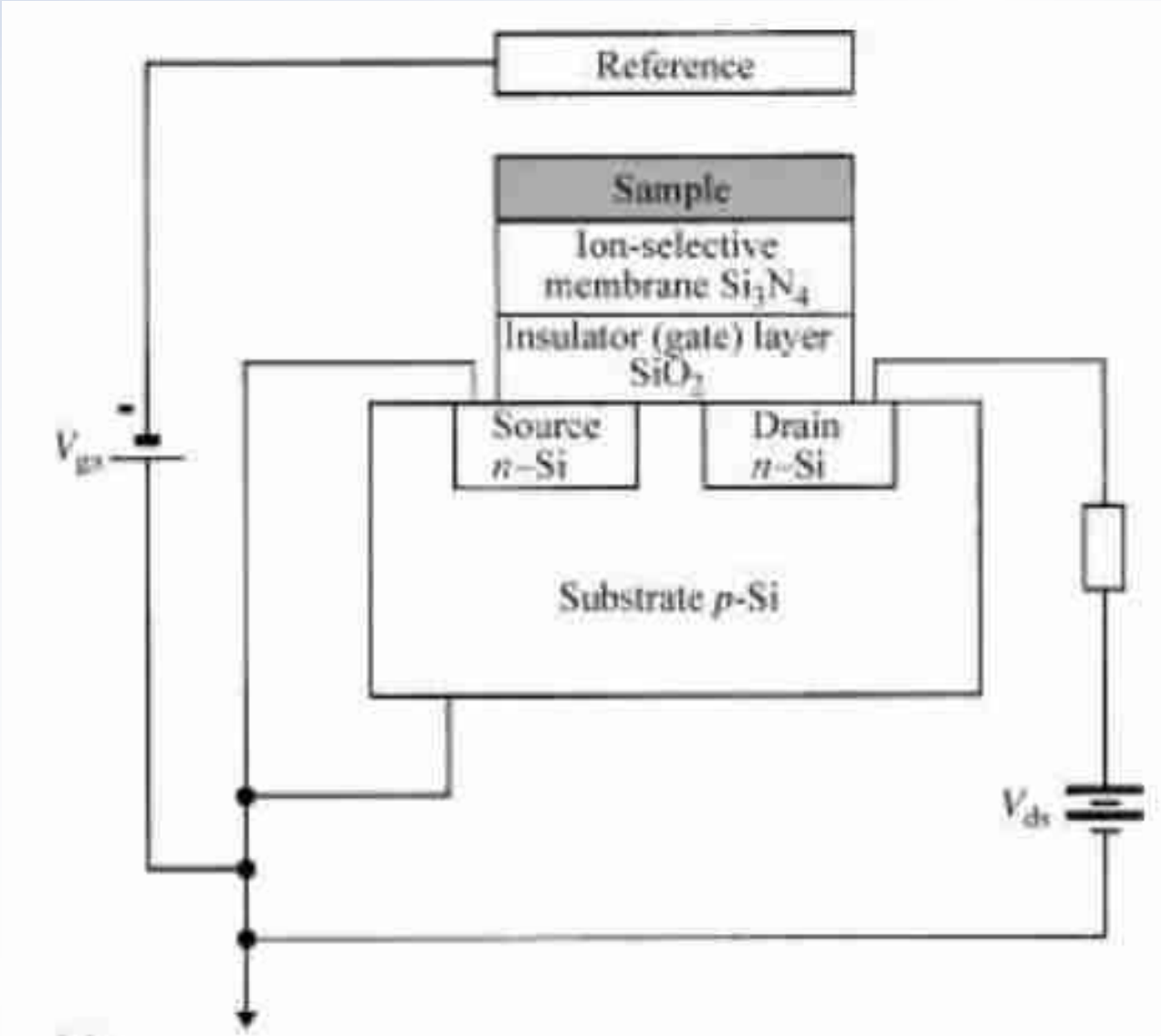
Light absorption by tissue



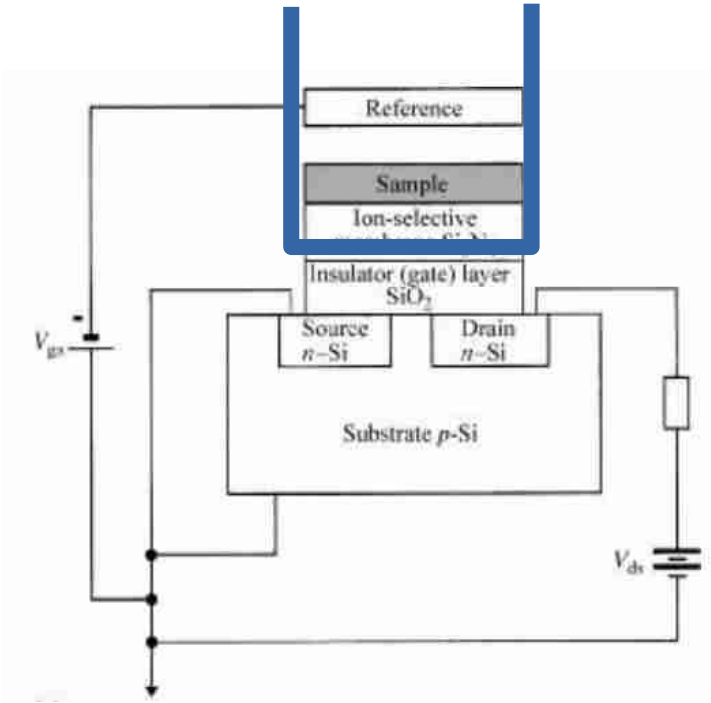
Light absorption and oxygenated haemoglobin



Ion-sensitive Field Effect Transistors



ISFET with sample holder



Intravascular sensor