Lecture 11

Chromatography
Instrumentation,
continued

Detectors

- **Ideal detector characteristics:**
- 1. Sensitivity (~10^{-8} to 10^{-15} g solute/sec)
- 2. Stability, reproducibility
- 3. Linear response (over several orders of magnitude
- 4. Temperature range Room T- 400 C.
- 5. Short response time, independent of flow rate
- 6. Easy to use
- 7. Similar (or predictable) response for all solutes
- 8. Nondestruction of sample

Flame Ionization Detector

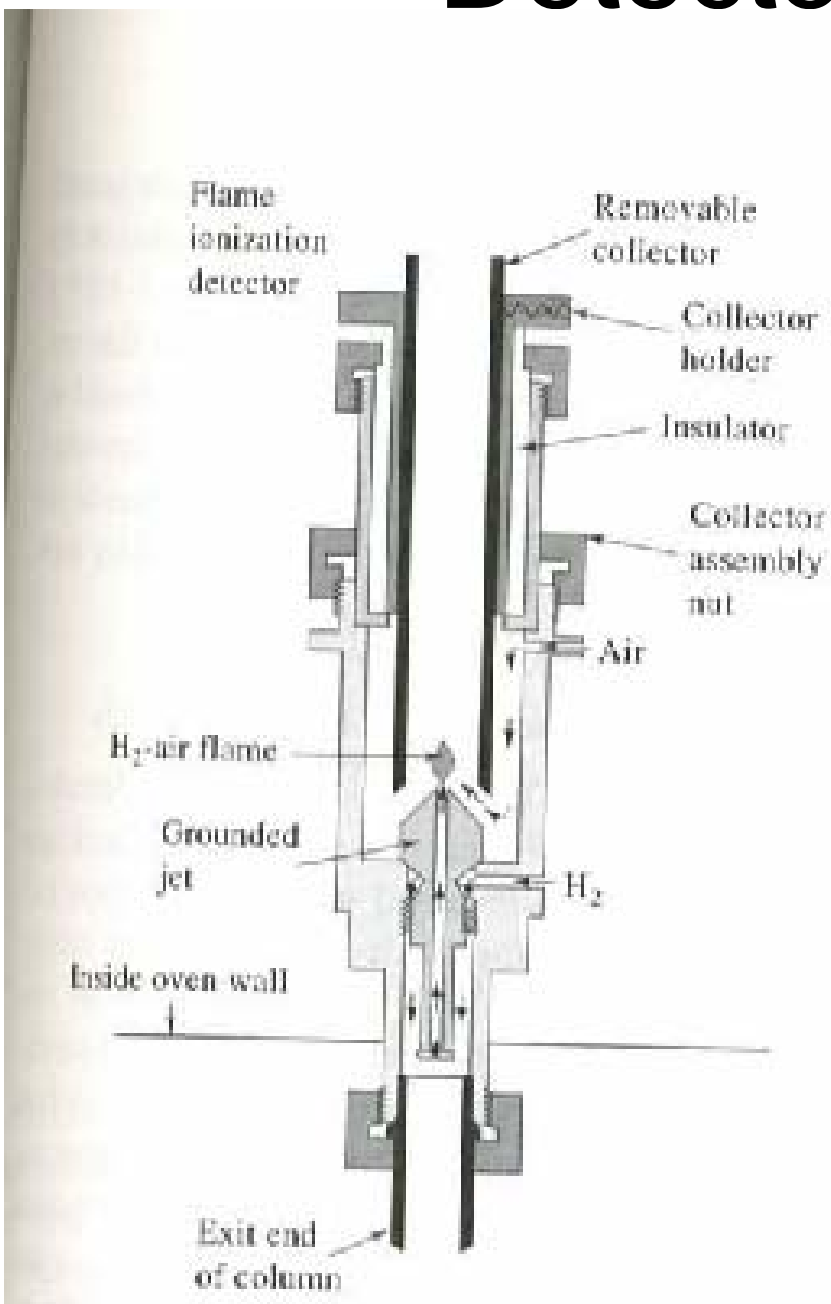


Figure 27-6 A typical flame ionization detector. (Courtesy of Hewlett-Packard Company.)

Most widely used GC detector

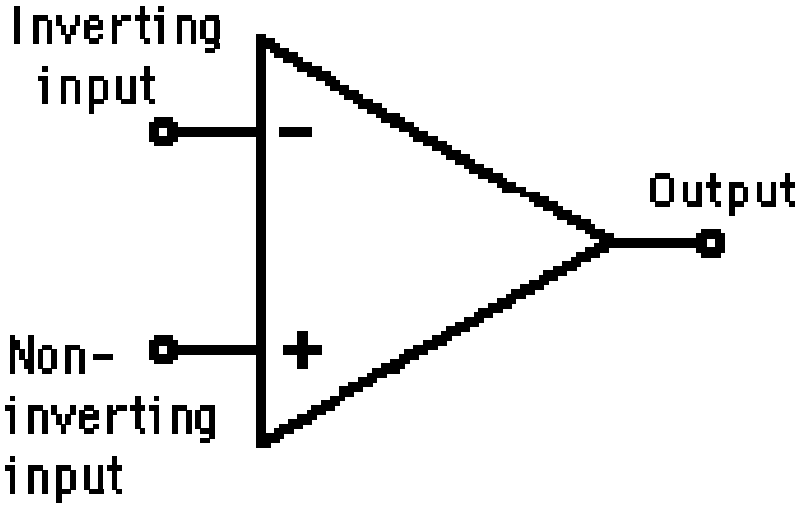
Ionization of carbon

No interference from H2O, CO2, SO2

High sensitivity (~10^{-13} g/s)

Operational Amplifiers

Some of the general characteristics of the IC version are:



- High gain, on the order of a million
- High input impedance, low output impedance
- Used with split supply, usually +/- 15V
- Used with feedback, with gain determined by the feedback network.

Characteristics can be understood with the help of the golden rules.

For an op-amp with external feedback

I. The output attempts to do whatever is necessary to make the voltage difference between the inputs zero.

II. The inputs draw no current.

Thermal conductivity detector cell

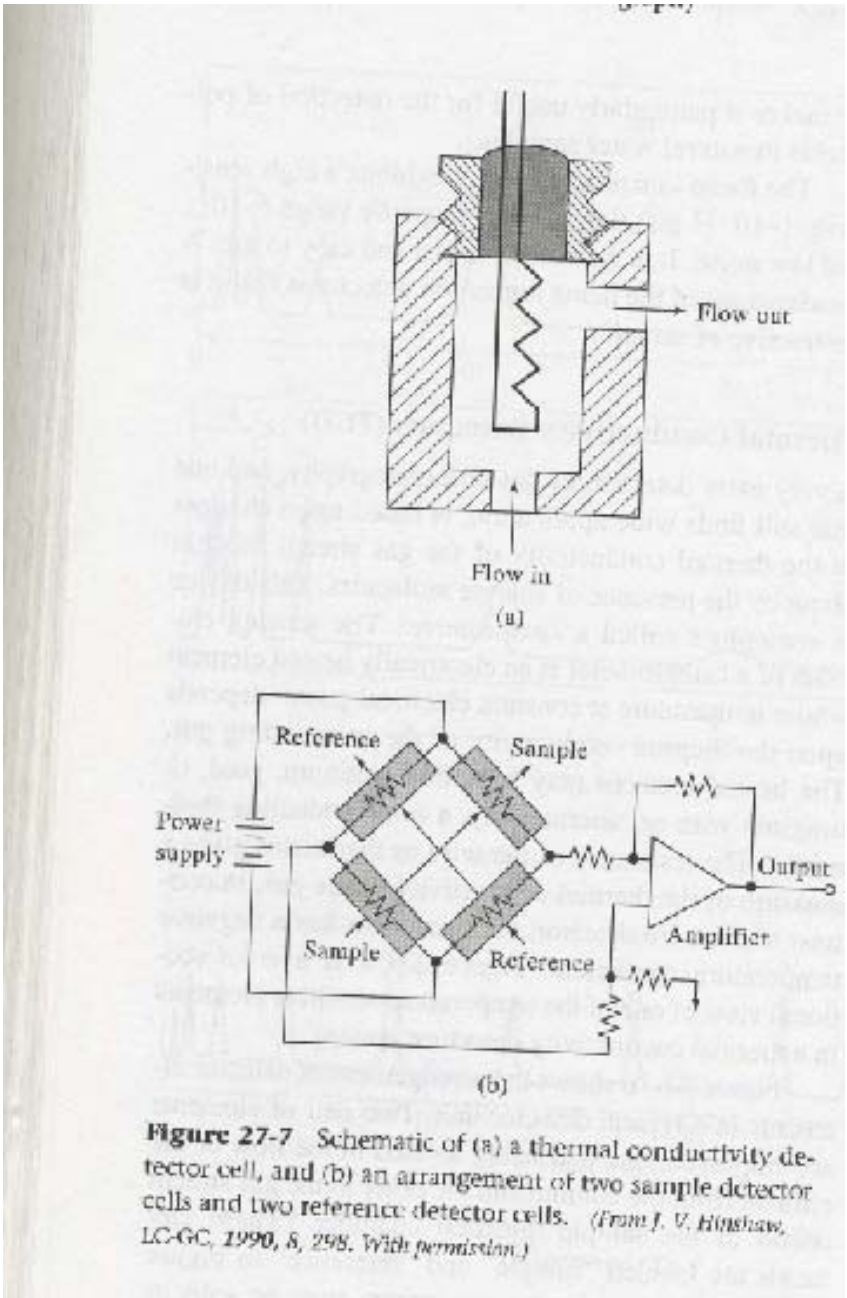
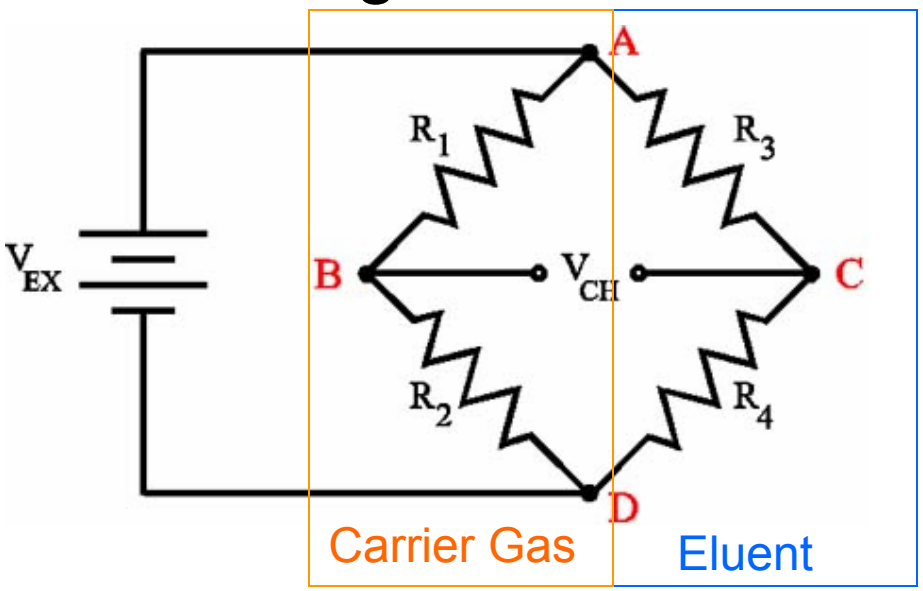


Figure 27-7 Schematic of (a) a thermal conductivity detector cell, and (b) an arrangement of two sample detector cells and two reference detector cells. *(From J. V. Hinshaw, LCGC, 1990, 8, 298. With permission.)*

Simple
Linear dynamic range of ~10^5
Low sensitivity ~10-8 g solute/mL

Whetstone Bridge is used to measure small changes in resistance.



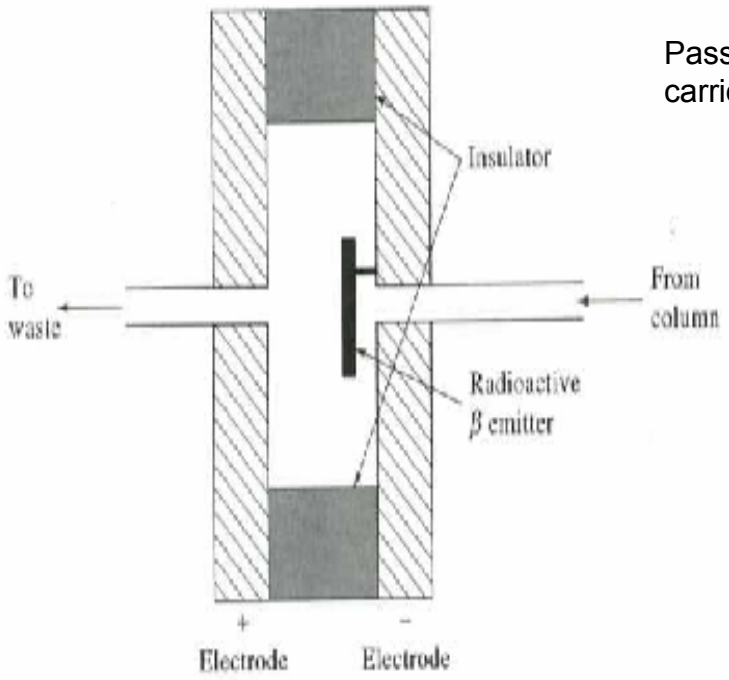
A The power supply labeled VEX produces a voltage across points A and D, so that VEX = VAD.

→ Current flows through each side of the resistor combination. (I left “I1”)= I_right “I3”)

Using Ohm's Law,
I1R1+I1R2 = I3R3+I3R4. (1)
If we assume that VBC = 0, then
VAB = VAC, (2)
I1R1 = I3R3, and (3)
I1R2 = I3R4. (4)
If we divide the equation (3) by equation (4)
R1/R2 = R3/R4 (5)

Solving for R3 gives .
R3 = R4*R1/R2(6)

Electron Capture Detector



Pass over beta emitter, carrier gas gets ionized

Figure 27-8 A schematic of an electron-capture detector.

-Use in environmental sampling

-Highly sensitive to halogens, pesticides, polychorinated biphenols (anything with electronegative functional group)

-insensitive to amines, alcohols, hydrocarbons

Atomic Emission Detector

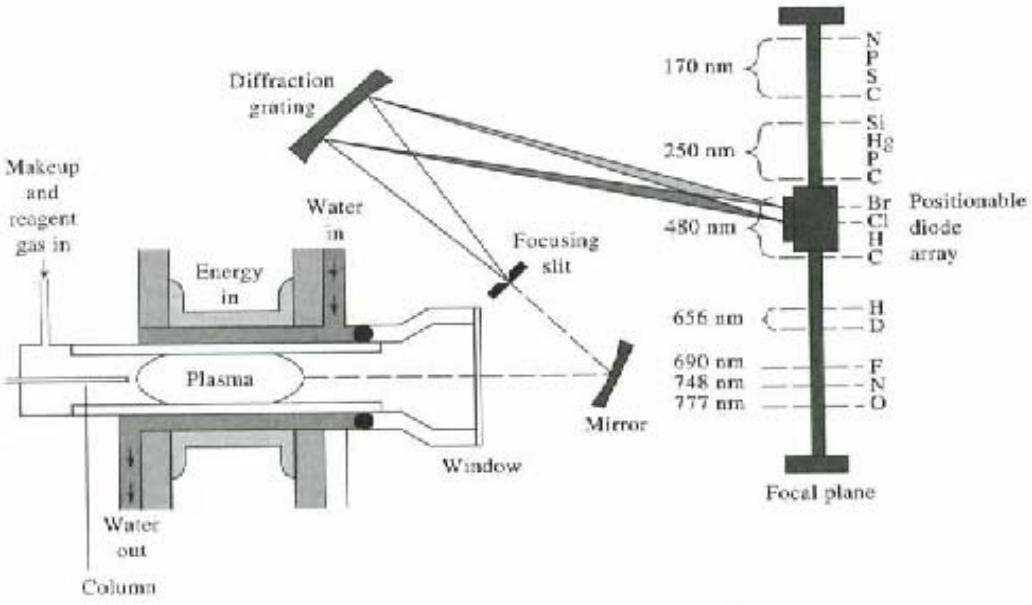


Figure 27-9 An atomic emission detector. *(Courtesy of Hewlett-Packard Company.)*

Atomic Emission Detector

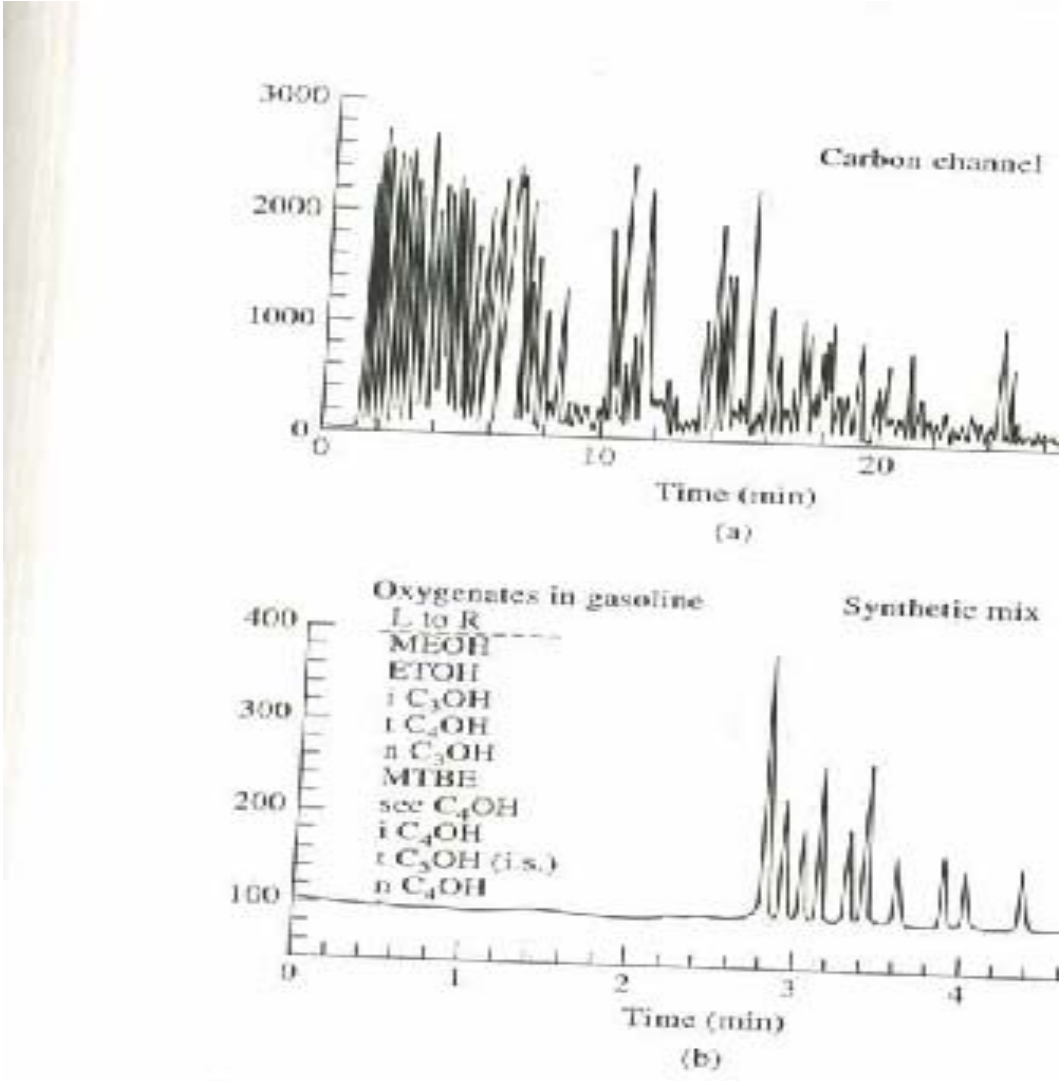


Figure 27-10 Chromatograms for a gasoline sample c
taining a small amount of MTBE and several aliphatic a
hols: (a) monitoring the line for carbon; (b) monitoring
line for oxygen. *(Courtesy of Hewlett-Packard Company.)*

Summary

- Choose the
- 1. Column
- 2. Detector
- 3. Operating Conditions that best suit your application

- Other measurement possibilities:
- GC-MS
- GC-FTIR
- Liquid-liquid Chromatography-

IC, HPLC